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FARM CHEMICALS

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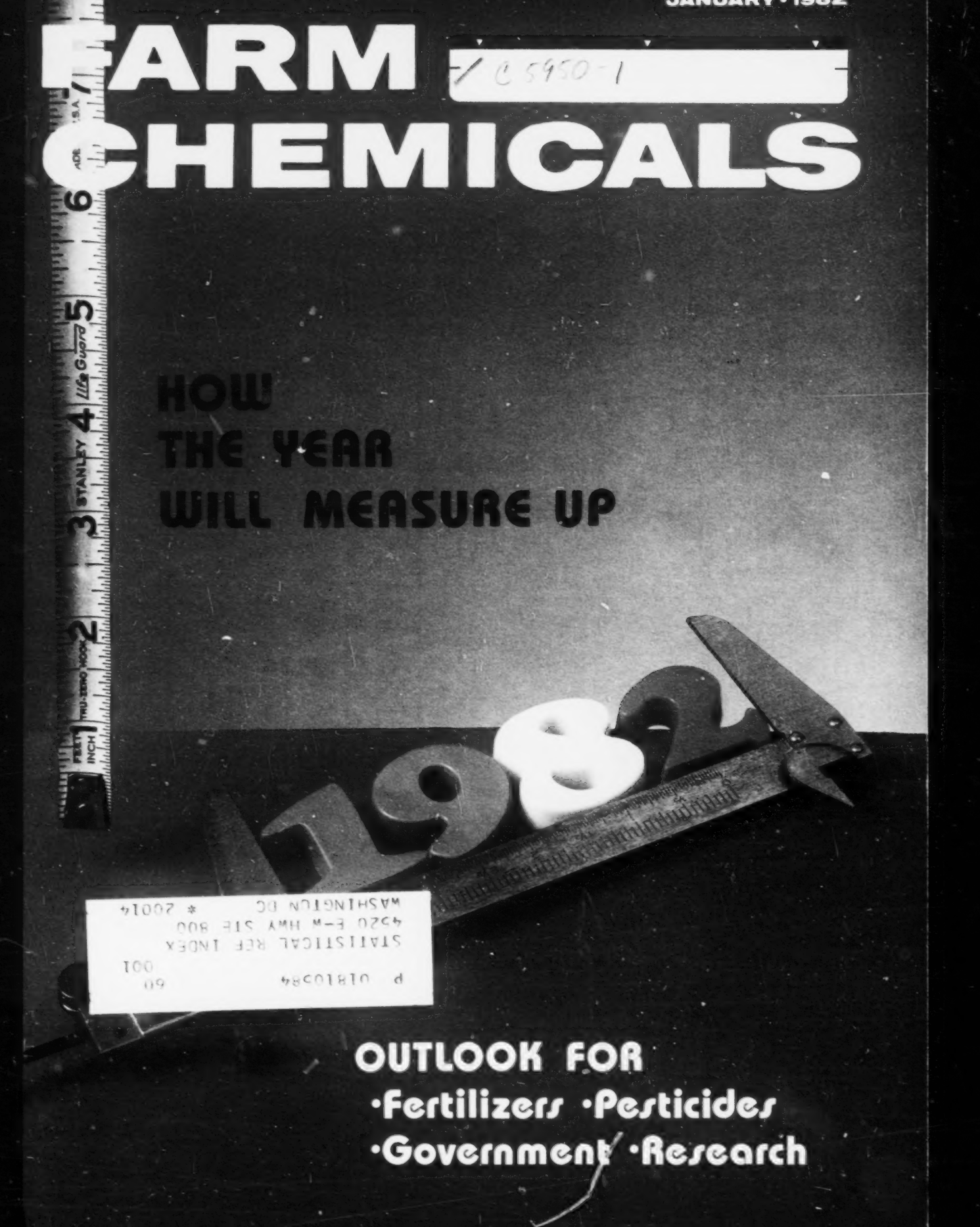
HOW THE YEAR WILL MEASURE UP



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How Will the Fertilizer Year Measure Up?

Get Ready for a Spring Rush!

Weather and poor crop prices combined to keep fall fertilization below recent years. Now, one expert predicts, "It looks like we'll be seeing the usual brisk spring rush of the old days."

PERHAPS the best word to describe the 1981–82 fertilizer year at its halfway mark is *slow*. Exports are down: According to TFI's *Fertilizer Index*, overall exports from July–October 1981 were down 30% from the same period in 1980. Overall domestic wholesale movement is also down; and at retail level, the amount of plant food that hit the fields this fall was down a good 15% from the previous fall.

There were any number of contributing factors. Overseas, the dollar's fairly abrupt new international strength has been hurting exports to those countries, notably in western Europe where the currency is normally hard. As IMC's Deneb Teleki puts it, "Some of our most important markets, such as Italy, France, and West Germany, find they don't like to pay 20, 30, and 40% more for a dollar, which is what they have to do right now."

Aside from the stronger dollar, important Brazilian imports from the U.S. were down by about half, due to internal policies that sharply tightened credit. "Once current adjustment is made in Brazil, though, things will get back to normal—probably by next year—and then we'll be seeing about 8% growth per year at the farm level," predicts Teleki.

Domestically, says Van Rogers of AMAX Chemical Corp., "Part of the blame might be put on weather conditions. But the crux of it is agribusiness economics. The dastardly prices of grain as well as livestock made farmers take a hard look at the situation, and many of them decided to wait 'til spring to buy spring planting inputs.

"And," he continues, "the farmer also remembered that last year he put down a lot of fertilizer in the fall, then he found out he could have bought it cheaper if he'd waited until spring. I'm sure *that* figured into his economics this year."

As far as the outlook for the spring and the next fertilizer year, few industry sources are willing to be anything but guardedly optimistic. Almost unanimously they predict that things will start turning around in the next 6 months or so. They'll have to, the reasoning goes, because the world can't afford to go on curtailing fertilizer use forever. However, few are willing to make any hard forecasts. A quote from one source more or less sums up the feeling, "I wouldn't *dare* forecast anything in this kind of business climate."

Teleki offers what is perhaps the most positive outlook, based on a bit of mathematical probability.

Commenting on the present situation he says, "I think this year we're seeing a return to seasonality in patterns of shipments, such as we had 5 and 10 years ago—smaller fall shipments and larger spring shipments. In other words, we'll be seeing the usual brisk spring rush of the old days."

He doesn't, however, expect this seasonality is back to stay. "I certainly hope not," he says. "The long-term advantages of fall fertilization remain, and my feeling is that when weather, prices, and interest conditions return more to normal, there will be more fall fertilization again.

"The brightest spot for 1982–83," Teleki goes on, "is simply the statistical unlikelihood that we should have such enormous yields per acre as to depress prices. Last year there was an all-time record high production of grain in the U.S., and paradoxically the excessive crop was bad for the farmer. Just a real good normal crop is what will make things better in 1982–83.

"While we *are* seeing a pause," he continues, "we definitely feel there is still a very good growth potential in the U.S. market. In fact, in our studies we've come to the conclusion that *there is a trend line of 3% consumption growth per year for fertilizer in the U.S. for the next few years.*"

Because of this trend line, he explains that even though consumption is down about 3% this year, it will eventually snap back to the norm. Here's the reasoning:

"Say consumption was 100 units last year, and now we're down 3%. The trend line has also gone up another 3%, so this year we're actually 6% under the line.

"However, if we go up 6% in 1982–83, we'll only be where we should have been this year—because the trend line will continue to climb. Therefore, in order to catch back up, consumption will either have to rise by 9% in one leap, or by 6% a year for two years running."

Can this happen? Tekeki points out that it has happened before—and not so long ago. "In 1977- 78, fertilizer consumption feli a bit over 6%. And when you asked people what the outlook would be, they didn't know. However, in 1979 consumption went up 9%."

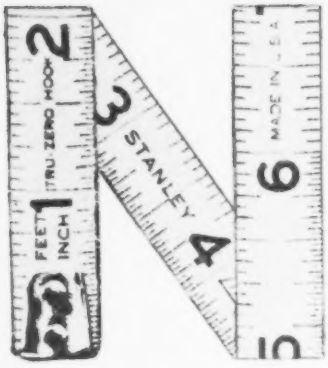
He recalls another similar situation earlier in the decade; consumption went down 9% in 1975, and it shot up 18% in '76.

So, which will it be? One 9% jump or two of 6%?

"It all depends," explains Teleki, "on how fast other things get back to normal. If most things turn in our favor, fertilizer consumption will bound back 9% in one year. If things take a bit more time to get back to normal, you'll probably have the two 6% jumps.

"But there's no question things *will* return to some sort of a central tendency; that's the very definition of a trend line."

So much for the overall picture. For reports specific to nitrogen, phosphates, potash, and sulfur, read on. **FC**



An Excellent Spring Coming Up

SIGNS point to a big spring rush for nitrogen fertilizer. Are you ready to handle it?

"A lot of products will be put on in a short period of time," predicts a spokesman for Terra Chemicals International Inc. Due to the limited fall application, a factor he attributes to wet, inclement weather in the Midwest, he's looking for a "very compressed season which could create logistics and supply problems."

Unlike some companies, Terra does not have a great oversupply of nitrogen products and, therefore, has not reduced production at any of its plants. Dr. Dick Balser, Agrico Chemical Co. agronomist, reports his company has "an adequate supply" of nitrogen at this point. With the supply end admittedly greater than the demand through this winter, he foresees that situation evening out "just as soon as we get application weather in the spring. I look for the spring of '82 to be an excellent season for nitrogen."

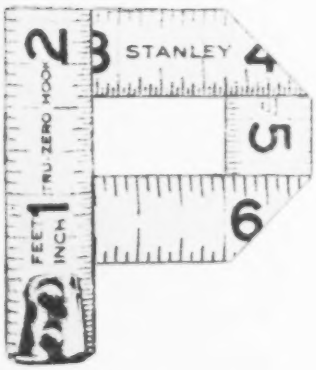
J. W. (Jimmy) Crooks, vice-president of First Mississippi Corp., believes the supply/demand situation will become more balanced for his company come spring. An excessive oversupply caused by reduced demand for DAP and MAP as well as for industrial ammonia uses siphoned a lot of ammonia into the ag market. The situation became so serious for First Mississippi that they were forced to make an unpleasant decision.

"We're the only ones I know of who have announced a permanent closure," says Crooks, referring to their Fort Madison, IA plant. (Several other companies shut down plants for a time, but at the moment all but a couple have come back on stream.) The measure served to reduce excessive supply, and Crooks now describes inventory as "slightly in excess of demand, but not terribly so."

It has become very expensive to produce a ton of ammonia, a fact compounding the oversupply problem. Mainly for this reason, while plants in North America were operating at an average of 95% capacity, James W. Brown of the Canadian Fertilizer Institute explains that plants elsewhere averaged 70% or less in 1981. Costs in the U.S. ranged from $120 to $140 per ton, not including storage, shipping, sales, and other miscellaneous costs. "We cannot expect many additional plants to open as long as the price of ammonia on the Gulf Coast hovers around $150 per ton," Brown declares.

He implies that although more plants are coming on stream outside the U.S., high production costs for facilities using naphtha, fuel oil and natural gas will prevent them from reaching production capacity. Even Soviet-produced ammonia should not be available on the world market in sufficient amounts in time to fertilize 1982 crops.

Brown expects nitrogen demand in the U.S. to run 2 to 4% over 1981, around 12.6 million nutrient tons. Exports, he says, are likely to total less than in 1981, especially for ammonia,



Look for a Good Average Spring

TO understand where phosphates are headed, we must first look at where they've been. And, of course, they've been in a state of lessened demand, depressed prices, and production cutbacks.

But why? In a talk before the Fertilizer Industry Round Table in early November, Eugene B. Graves of Agrico Chemical Co. explained the problem's evolution:

Springtime, he pointed out, brought a higher value for the U.S. dollar, making American fertilizer a much less attractive buy overseas. So exports slowed down. Back home, a combination of droughty winter weather and a snailish farm economy led to delays in domestic take.

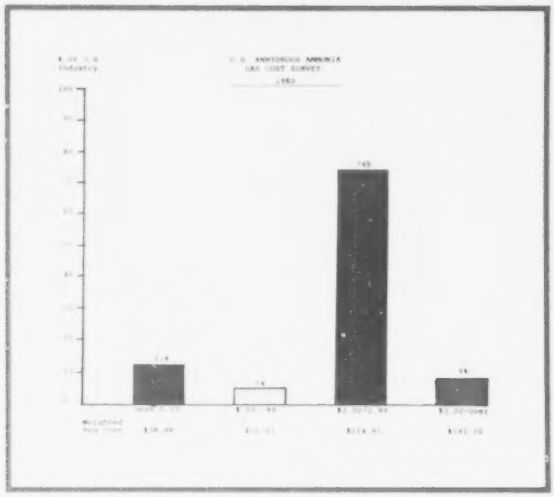
"As a result," said Graves, "inventories this year peaked in March, 60 days earlier than they had in the prior year, and were not quickly drawn down as is usually the case. At that point, we began to have price pressures on our phosphate products."

He pointed out that the industry continued to barrel along at full production in spite of the lessened demand. "Had the industry reduced overall operating rates to a level of 95% this past spring, there would have been a substantial reduction in price pressures."

This didn't happen, though. Or, rather, it didn't happen until prices fell so far as to reach the marginal cost level. And *then* curtailments began. According to IMC's Deneb Teleki, "Overall, July to December, we're seeing a good cutback from what we had a year before."

Van Rogers, vice-president of domestic sales at AMAX Chemical Corp., while he doesn't look for any significant further cutbacks, sees "no expansion until well into 1982—if then."

He then goes on to say the Rx for future healthy phosphates will be an improved total world economic situation, which he believes may start to turn around—as concerns fertilizer—by about mid '82. He also looks for an improvement in ag commodity exports, "which will take down grain inventories, and at that time, you'll begin to see a very definite improvement on the part of ag income."



urea, nitrogen solutions, and DAP. Last year U.S. nitrogen exports were down 430,000 tons during July-September, compared to the same period in 1980. However, he stresses, 1981 as a whole was a banner year for nitrogen with exports at 3.1 million tons, 17% above 1980. Imports (mostly urea), on the other hand, declined 5% during 1981 to 2.5 million tons N, and Brown anticipates they will remain down or drop even lower in '82.

"The U.S. nitrogen supply/demand balance is expected to be in close equilibrium for the 1981–82 fertilizer year. Any major swing in consumption, production, exports, or imports could change this delicate balance," predicts Brown. "Ammonia plants are expected to operate full out at better than 93% of designed capacity. Supplies of nitrogen fertilizers should be adequate to meet anticipated demand during the 1982 fertilizer year. The year, as a whole, should experience no major problems."

Prices remain generally soft at presstime, but each manufacturer contacted, without exception, anticipates they will go up. Still, says the Terra spokesman, "Our selling prices have not increased in line with the energy costs to produce the product."

Credit appears to be loosening somewhat. Balser, who emphasizes this is not his area of expertise, states he has observed credit becoming "less tight-fisted" than it was two years ago, but he thinks the situation is going to stay "fairly orderly." The Terra representative adds his company "has good credit policies for our sizable retail trade. We enforce them, and our operating people adhere to them."

Balser also has noted a change in purchasing patterns. "People aren't buying ahead the way we experienced before. We were reducing that spring peak level a bit, but this year it looks as if we're going to see an even greater spring peak in nitrogen demand," he predicts. "I think a lot of people are anxious to put fertilizer on, especially those who couldn't last fall because of the bad weather and late harvest. They're really looking forward to the first chance they get in the spring to get out there and get it on." **FC**

How about prices? Says Rogers, "Even though we've seen some expression of an increase in P prices (at this writing they were around $190–$195, up from the nadir of $170), we're still considerably below cost of production. However, I think we'll continue to see a strengthening of prices. We'll possibly be seeing DAP up in the $210 range this spring. Sure, that's still pretty doggone low with reference to cost of production, but it will be a lot better FOB central Florida than what it's been over the last 8 months."

Despite the softened prices, movement this past fall was on the weak side. IMC's Teleki points out that farmers put down about 15% less than they did the previous fall, due to low corn prices, high interest rates, a late harvest, and some uncertainty about spring planting plans. He does look for movement to improve in the spring. However, "Fall will be down more sharply than the spring will be up; so, for the year, phosphates should be down about 3% at the farm level."

Exports were also down—and not entirely due to the stronger dollar. Teleki reminds us that exports to the largest taker of U.S. phosphates—Brazil—aren't vastly affected by the dollar's relative value. Instead, it was tightened internal economics that caused Brazilian imports to be down by about 50% this year. "Next year, though," he predicts, "they will probably be back to normal."

Rogers also believes things will be better in the spring. "I think we'll have a good, average spring. Or, if our retail customers will inventory sufficiently ahead of the spring movement, we'll have a chance of a very good spring. Because the farmer is going to put out fertilizer when he gets ready to plant. In fact, where fertilizer *was* put down this fall, the dealers tell us they didn't see much cutting back on application. But, if everyone waits to order, we could have a whale of a logistical problem."

Looking past the curtailments, there's apparently no problem on the supply horizon. Agrico's Graves points out that quite a bit of new capacity "will be in place by the end of this year. IMC will be completing their 500,000-ton expansion, and Texasgulf will do likewise. The W. R. Grace/USS Agri-Chemicals joint venture will be coming on stream during the latter part of 1982."

Along with a number of other increases, Graves says the industry will see a 1.5 million ton increase by late 1983.

He anticipates longer term U.S. supply/demand should "be pretty much in balance within the next 24- and certainly no more than 36-month period. This of course depends upon the export market, since that is where the basic growth is. This means the industry will have to run at about a 92% operating rate in 1981–82, and gradually increase the operating rate back up to an estimated 100% by 1984–85."

On long-term P_2O_5 exports, Graves sees a hefty increase—to perhaps 6 million tons in '85, compared with 4.6 million in '81. This rise will come from "increasing awareness of lesser developed countries of the need for a balanced nutrient program." **FC**

Hairline Decline in Deliveries

"POTASH movement was slower than anticipated during the fall," reports a spokesman for the Potash Corp. of Saskatchewan (PCS), voicing a concern that was apparently true through most of the industry. Of course, things could have been worse: "We actually did end up with a reasonably good November, and had the snow conditions not hit the Midwest in late November, we would have had a very good November. But I think it's true to say that our sales to date (mid December) are less than had been projected."

AMAX Chemical Corp.'s vice-president for domestic sales, Van Rogers, agrees that "K movement was disappointing as it relates to what was planned and forecast by the majority of the industry.

"Part of the blame," he continues, "might be put on the weather condition, but the crux of it is really the economics of agribusiness as a whole."

"Two factors have to change before there is any real improvement in the potash situation," continues Dean Gidney, president of the Potash Company of America (PCA). "One is the price of farm commodities, and the second concerns the export market and the dollar's relative value overseas. This will have to be reduced before we see any major improvement."

The slowed demand, however, apparently hasn't had the effect on potash that it had on phosphates and, by association, sulfur. Deneb Teleki at IMC sees "a hairline of decline in domestic wholesale deliveries this fertilizer year, and maybe a 2% decline at farm level." This is compared with 3% for P and, according to AMAX's Rogers, "possibly 3–4% on fertilizer in total this ag year."

On the pricing front, Gidney allows prices have come down some. "And it's my feeling that they should not come down any further, simply because they've gotten down to a level now where they are not high enough to justify all the big new investments that are being planned and carried out. In fact, in some cases, they're probably not even high enough to cover costs.

"I think any further reductions would see some diminution in the supply, perhaps by some companies stopping production."

According to Roy Romanow, chairman of the board at PCS, 1981 production levels at the five PCS mining

Still Tightly Balanced

AS phosphate goes, so goes sulfur? Well, maybe things aren't quite that simple, but talk to sulfur suppliers about their commodity's near-term outlook, and you'll also hear plenty about P_2O_5.

As one industry source expresses it, "The phosphate industry is really in a very slow position right now, and since they consume more than 60% of the sulfur, naturally it has to spill over to our industry for awhile.

"This time last year," she went on, "we had a very tight situation, and the whole industry was pulling out of inventory. Compared with that, we're seeing a flat picture in '81, and that's definitely because of P."

J. C. Anderson, vice-president of potash-sulfur at Duval Sales Corp., is confident that "the present situation isn't going to last forever. No question it will turn around, probably sometime in mid 1982, and the market will start growing again."

Another source points out, "Underneath, I'd still characterize S as being in very tight balance over the long haul, say the next 5 to 10 years. Most of it will depend on the position the phosphate industry is in. When phosphates turn down, like now, you'll see material flowing into inventory; and when they're really booming, you'll see some coming out. It's just that tightly balanced."

Meanwhile, suppliers are taking the opportunity to get their inventory levels back up. One expert states, "Inventories hac reached a level of less than 3 million tons—or 3 months domestic supply—which is considered minimum." The decreased demand has reportedly freed up 300,000–400,000 tons for inventory increase, and "some replenishing of stocks is indeed taking place."

How about future supply? "Two or three unanticipated factors have entered the world picture in the last few years that have shut off a lot of sulfur supply," one spokesman relates. "The Iran/Iraq situation, for instance, has stopped most S production there, which was about 700,000 tons a year. The Canadians, in turn, saw a tremendous advantage to start to pull out of stockpile, which is what they're doing. They are breaking all kinds of records in exporting sulfur right now."

"At that rate of remelting," says another, "depletion would come about 1990."

New supply is needed, but where will it come from? Probably not from frasch. "Most of the economic frasch deposits are already being exploited," points out one source. "We're actively exploring," reveals another, "but so far there have been no new deposits found."

"I think," says a third, "that the market will be increasingly dominated by by-product and recovered sulfur rather than frasch."

In the U.S., new recovery plants are being set up in the Overthrust belt and the Mississippi area. "There are 30-odd sulfur-producing facilities associated with gas plants or oil refineries expected to be constructed between now and 1983," goes one report. "Perhaps 1.5 million tons is a good guess as to expected annual tonnage. Another 200,000 tons should be coming out of the Duval Phillips Ranch property by that time."

One commentator reminds us,

divisions will be approximately the same as 1980's record production levels. He also refuted rumors that there would be massive production cuts and layoffs owing to the weakness of the marketplace.

"It is the policy of the Potash Corporation," explains Romanow, "that there will be no layoffs at any of its operations and that during this temporary period of lower than anticipated demand, the Corporation will build inventory at its mine sites. We believe the market will improve significantly in the spring of 1982, and that in fact, higher inventory levels will be of benefit to us in helping meet demand in the long term."

This reduction in potential production, says PCS, is being achieved by cutbacks on holidays, avoiding unnecessary overtime, and by pulling needed maintenance and renovation.

Rogers is confident that "you're going to find a strengthening in K prices. I don't see any dramatic increases; I think you'll see the present levels hold, and perhaps some price increases will be put into effect as it relates to the next ag year by July 4th."

How about spring? The suppliers' move toward beefing up inventories offers a clue: "We're building our inventories," says a PCS spokesman, "in anticipation of a very strong spring movement."

Again, however, the problem of logistics clamps something of a damper on the heightened expectations.

"The outlook for spring," continues the PCS source, "may be very hectic. The season's expectations are for increased plantings, acreage wise. But the present economic situation makes it seem unattractive to build inventory at dealer level. If we don't experience adverse weather and shortages of rail car supply, then I think there will be adequate inventory to support in-season demand. But it will be difficult if we have to move all that product into position in a relatively short period of time."

As to the potash outlook for the '82–'83 fertilizer year and beyond, one source emphasizes, "Everything basically depends on any improvement in the farm economy and commodity prices. If there are indications of strengthening there, I'd be somewhat optimistic as to the outlook. If commodity prices continue to stay at low levels, I can't in truth be all that encouraged."

While Dean Gidney finds the spring outlook "questionable" due to the variety of "ifs," he's considerably more optimistic about '82–'83, especially in terms of exports. This is because, "I believe the surpluses in some areas of the world are being worked off pretty fast. In particular, in Brazil and in Japan advance buying built up large inventories. But now they're being pulled down, so I think 1982–'83 might just see a fair improvement." **FC**

though, that "U.S. production of by-product S will be closely tied to the demand for natural gas." Another agrees if the demand for energy stays low, the gas producers aren't going to bring their new fields into operation.

And even when they do, "It would be in their best interest to produce sweet gas before the sour. So, it's really a question of gas economics rather than S economics."

In any case, one man speculates that the new sources could lead to an oversupply situation for 1982–83. However, "This is likely to be temporary, with a return to tight balance in 1985."

In Canada, six or so new gas-processing plants are due by 1983, adding about 1.1 million tons per year. One source believes overall Canadian production may peak at "perhaps 7.3 million tons in 1985, after which it will decline, although partially offset to an increasing extent by new gas discoveries and oil sands operations."

For the rest of the world, Mexican exports are expected to stay at about 1.2 million tons/year, perhaps rising somewhat until 1985, "when their own needs will receive priority." Poland's proposed Skepanie mine could add 1 million tons to world production by 1985, and that same year Mid-Eastern production may reach 2.5 million tons.

"Saudi Arabia may become a sulfur breadbasket," one source predicts. "They already have about half a million tons in inventory, and they'll probably be exporting about a million tons in the next 2 or 3 years. This will probably take the place of some of the sulfur that Canada was formerly exporting to the East."

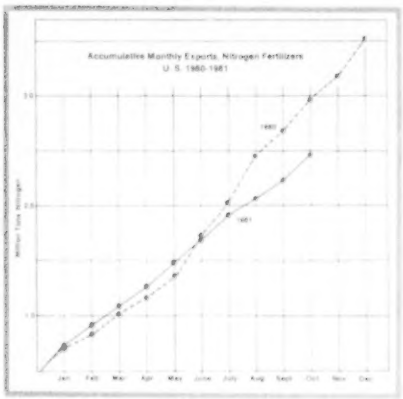
What about spring? Two of the suppliers answered with an honest "I don't know." "It really depends on what happens to phosphates," continues one, "which in turn will depend on such things as weather, interest rates, farm prices and the strength of the dollar overseas."

One supplier, though, has an upbeat outlook. "I don't think there's going to be any wild tonnage increase," he points out. "In fact, I think there might be some loss of fertilizer tonnage this spring. But I also believe the spring will be better than most people think. I believe '82 will be the turning point, that '83 will be better, and '84 better still." **FC**

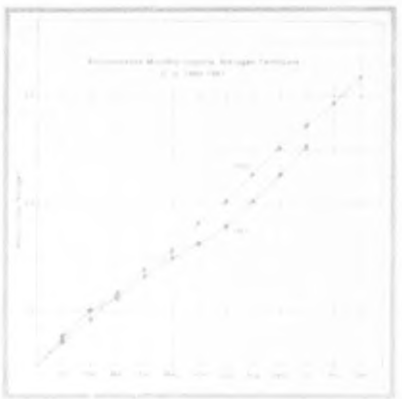
Looking for Good News

SPRING. No one is looking forward to it more than fertilizer traders. By then, they hope, a complex series of negotiations and renegotiations will have fallen into place and they'll be better able to predict international movement for the 1982 season. In the meantime, everyone is guessing.

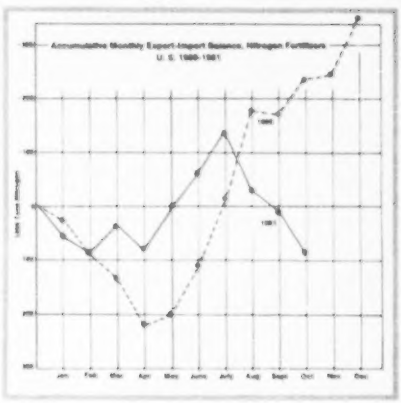
In New York City, Carl Welborn, who describes himself as Gazocean's "historical janitor," uses that frame of reference in forming his opinions. He believes exports will pick up, "just by judging from historical data. The U.S. has always exported 300,000 to 700,000 tons of anhydrous ammonia a year. I would tend to think that type of flow will continue. Unless," he



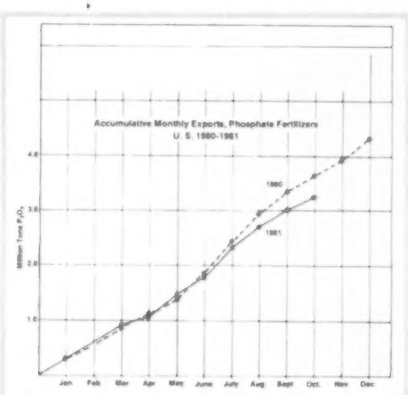
One of the major problems facing the nitrogen industry today is the abrupt reduction in total nitrogen exports beginning in June 1981. From January to May 1981, exports of total nitrogen fertilizer materials were running about 15% ahead of exports in the same timeframe in 1980, Exports of total nitrogen in June 1981 were only approximately 210,000 tons as contrasted with 358,000 tons in June 1980. Each month after that, exports were significantly lower in 1981 than they were in 1980. By the end of October, we had exported 0.5 million tons less nitrogen material in 1981 than we did in 1980, and none of our traders see any reason to expect this trend to change. This means we have 0.5 million tons of nitrogen in U.S. inventories—0.5 million more than we had expected or needed.



Likewise, our imports of nitrogen fertilizers have decreased; however, the decrease is much smaller than was the decrease in imports. We have decreased our imports of ammonia from the U.S.S.R. significantly and have decreased our imports of urea from Canada as Canadian domestic use increased.



The export situation on phosphatic fertilizers is likewise dismal. During the first half of calendar year 1981, we exported almost the same amount of P_2O_5 that we had exported in the same six months a year earlier. Exports had not increased as we had expected and as had been the case in past years. But we did hold our own during the first six months. In the succeeding four months, however, our exports decreased significantly, and by the end of October we had dropped almost 400,000 tons P_2O_5 from the levels of 1980. Again, our international traders see little hope for an early reversal of this trend toward decreased exports of P_2O_5 as contrasted to our normal expected increase. The net result has been rapid buildup of inventories followed by a closure or restriction of total production, totaling somewhere between 30 and 40%.



The accumulated net result on the export/import balance sheet for nitrogen fertilizer in 1981 has been significant. By the end of October 1980, we had a positive trade balance in nitrogen fertilizers of over 235,000 tons. To the contrary, in 1981 by the end of October, we had imported over 80,000 tons more nitrogen than we exported. In short, we are losing our position as a net exporter of nitrogen and have become once again a net importer even in the face of decreasing imports.

stresses, "there is a massive cutting back of plants in the U.S."

Welborn describes that possibility as part of a "gut decision by the industry to hang in tough and shut down capacity in an attempt to return prices to a profitable level." Emphasizing he suspects he'll be more optimistic in about three months, he adds, "From where I sit, right now I'm scared to death."

Hugh (Hoopy) Ten Eyck of Ten Eyck Associates in Dunedin, FL places his hopes for recovery on the grain and commodity market, not just in the U.S., he stresses, but in the rest of the world also. "That part of the economy is in more than a recession; I'd call it a depression. Until that part of the market picks up, I don't think we're going to see any material movements in the commercial (non-government) fertilizer market," Ten Eyck asserts.

A trade source, wishing to maintain his company's low profile through anonimity, agrees with Ten Eyck's assessment that it is a global problem. "The whole world is suffering from the cutback in consumption of all fertilizers. We in the U.S. seemed to have the same consumption in the fertilizer year ending June '81 as we had the year before, but globally there's been a substantial cutback, particularly in phosphates," he attests.

World consumption levels for phosphates, the source explains, fell to the 1975 level. "That's the problem with the industry in the U.S.," he continues. "With phosphate exports off, particularly DAP, there are a number of nitrogen plants shut down right now because of insufficient demand in export."

Ten Eyck sees movement to government markets, such as the Peoples Republic of China (PRC) and India, continuing but at a lesser extent. Finances there are not as vulnerable to the variances of the grain market as are those of more independent purchasers, he explains. However, Ten Eyck foresees these countries bargaining "for the very best price they can get. They'll use delaying tactics or whatever tactics that fit the issue. As a result, their purchases may be late, they may be less, and they may be spread out more over a period of time."

Potash prices rely most heavily on the grain market, Ten Eyck believes, while phosphate prices depend on "the ability of Phoschem (the Phosphate Chemical Export Association) to hold the prices they've set." As for nitrogen, he calls the international market "completely unpredictable. You never know what's going to happen to it."

Another industry source, who chooses not to be identified, mentions that Phoschem's efforts to attract new members, coupled with curtailments of production, should reduce supplies and balance the situation. He stresses that curtailment may not be the "happiest angle of approach," but it might

(Continued on page 23)

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Fertilizer Outlook

(Continued from page 18)

be the most promising to "get prices up some." He adds that the situation can turn around fast because "there's a good deal of DAP business starting to come out of the woodwork as some buyers have realized they've missed the bottom and prices are climbing."

What Happened in '81?

"We lost more than our share last year because of the Polish situation," explains W. J. (Jack) Turbeville of the Phosphate Rock Export Association (Phosrock). "The Florida industry as a whole and Phosrock in particular had been shipping rather large quantities of rock to Poland. In 1981 their economic situation, coupled with the political aspects, made it impossible for them to get the credit necessary to purchase rock from us."

Turbeville hopes the turmoil in Poland "settles down a little for their own sakes even more than for ours." If it continues, he says Phosrock expects exports to countries other than Poland to "improve modestly in '82, but certainly not return to 1980 levels," even though significantly lower ocean freight rates promise to boost Phosrock's competitive standing. World phosphate rock consumption, he concludes, probably will not increase more than 2–3%.

Emil S. Finley, president and chief executive officer of International Commodities Export Co. (ICEC), believes the problem is the result of a move to reverse the inflationary economic policies of the past 40 to 50 years. "The advent of a new administration and economic thinking in the U.S. is a vast departure from the pattern, and it is a major economic as well as political change. This has had a profound effect on the situation in the U.S. and also a great impact on the economies of the world," he says.

A conservative tightening up of many inflation-ridden economies, including those of such countries as Brazil, has "made it very difficult to carry on normal export activity," explains Finley. "Fertilizer has not escaped this process, and I think it is very clear that over the last six months or so exports of U.S. fertilizers and fertilizer raw materials have dropped from 20 to 50%, depending on type."

While admitting it is a painful means of reducing inflation, Finley points out that "our inflation syndrome has been reduced by at least half. A year ago we thought in terms of double digit inflation; now we're clearly exposed to single digit inflation. Some people are talking about 6% being a possibility this year. It probably will take some time, maybe years rather

(Continued on page 92)

Nitrogen
(Thousand Short Tons)

	1980			1981		
Month	Exports	Imports	Net Export/ Import	Exports	Imports	Net Export/ Import
Jan.	203	232	−29	227	284	−57
	(203)	(232)	(−29)	(227)	(284)	(−57)
Feb.	142	204	−62	188	220	−32
	(345)	(436)	(−91)	(415)	(504)	(−89)
Mar.	178	223	−45	174	120	54
	(523)	(659)	(−136)	(589)	(624)	(−35)
Apr.	138	224	−86	166	213	−47
	(661)	(883)	(−222)	(755)	(837)	(−82)
May	192	170	22	225	149	76
	(853)	(1053)	(−200)	(980)	(986)	(−6)
June	358	269	89	210	146	64
	(1211)	(1322)	(−111)	(1190)	(1132)	(58)
July	307	193	114	223	142	81
	(1518)	(1515)	(3)	(1413)	(1274)	(139)
Aug.	434	259	175	142	250	−108
	(1952)	(1774)	(178)	(1555)	(1524)	(−31)
Sept.	238	244	−6	189	226	−37
	(2190)	(2018)	(172)	(1744)	(1750)	(−6)
Oct.	279	212	67	208	286	−78
	(2469)	(2230)	(239)	(1952)	(2036)	(−84)
Nov.	209	202	7			
	(2678)	(2432)	(246)			
Dec.	354	246	108			
TOTAL	(3032)	(2678)	(354)			

Figures in ( ) are accumulated totals

Source: John O. Douglas, TVA. Compiled from TFI Summary Export/Import Data Sheets

Phosphates
(Thousand Short Tons P_2O_5)

	1980			1981		
Month	Exports	Imports	Net Export/ Import	Exports	Imports	Net Export/ Import
Jan.	280	19	261	299	25	274
	(280)	(19)	(261)	(299)	(25)	(274)
Feb.	249	20	229	273	16	257
	(539)	(39)	(490)	(572)	(41)	(531)
Mar.	337	16	321	303	27	276
	(866)	(55)	(811)	(875)	(68)	(807)
Apr.	231	25	206	209	24	185
	(1097)	(80)	(1017)	(1084)	(92)	(992)
May	256	19	237	343	26	317
	(1353)	(99)	(1254)	(1427)	(118)	(1309)
June	487	12	475	383	18	365
	(1840)	(111)	(1729)	(1810)	(136)	(1674)
July	557	12	565	535	8	527
	(2417)	(123)	(2294)	(2345)	(144)	(2201)
Aug.	516	17	499	370	18	352
	(2933)	(140)	(2793)	(2715)	(162)	(2553)
Sept.	414	23	391	288	21	267
	(3347)	(163)	(3184)	(3003)	(183)	(2820)
Oct.	301	18	283	262	28	234
	(3648)	(181)	(3467)	(3265)	(211)	(3054)
Nov.	265	18	247			
	(3913)	(199)	(3714)			
Dec.	425	27	398			
TOTAL	(4338)	(226)	(4112)			

Figures in ( ) are accumulated totals

Source: John O. Douglas, TVA. Compiled from TFI Summary Export/Import Data Sheets.

Fertilizer Outlook

(Continued from page 23)

than months, to correct several decades of excesses in the socio-economic area."

Another trader attributes 1981's dilemma to "a number of problems that coincided. The shortage of foreign exchange in some countries, the disastrous domestic fertilizer season in Brazil, inventory carryover, and a strong U.S. dollar all worked against us.

"In addition," he continues, "new urea and potash production from Russia came on the market strongly for the first time, and the PRC experienced unusually bad weather. Also, India tried to change their distribution system by reducing direct subsidies to farmers who used fertilizers to increase food production. Many farmers couldn't afford the added costs, so there wasn't as much movement as there had been. All of that has been combining to make it so tough."

Explaining the Brazilian situation his counterpart alluded to, Ten Eyck reports that government sanctions in that country have "pretty well screwed up" that market. Inventories are heavy, and they're "trying to protect the domestic market to whatever extent they can," he explains. In the meantime, a new urea plant has come on stream, placing Brazil for the first time in an export position. Ten Eyck feels, however, that this is temporary and Brazil will be able to supply only its domestic market when inventories are reduced.

"With Brazil's great distances, it's possible to have an export situation in the north and an import situation in the southern part," says Ten Eyck. "Coastal freight rates are so exorbitant that it's often cheaper to ship from the U.S. Gulf Coast to southern Brazil than it is to pay domestic coastal freight charges."

Recovery When?

"Manufacturers all over the world are losing money," observes one trader. "We are experiencing a troublesome, expensive dip. Although the outlook is bleak, I expect the situation to improve at least by late summer if not this spring."

He selects this time period because, he says, "Nitrogen producers can't afford to produce at present spot price levels. Eventually, if enough people start to cut back or refuse to participate, there should be a modest price improvement by the middle of the year."

Welborn concurs, speculating that producers may reach a point when it would be "better just to stop production. People are losing too much money." But he does admit to a feeling of optimism when he looks to the Far East, particularly Korea, Japan, Taiwan, and Malaysia.

"I think imports of ammonia will commence to that area simply because it represents a cheaper alternative than running their own naphtha-based plants. But that's presupposing that cost of naphtha as a feedstock is going to remain the same as it is today or, in fact, increase in price."

Future markets on Phosrock's speculation list include the area of Oceania—Australia and New Zealand. Turbeville explains, "They have through the years supplied their own rock from Christmas Island and before that from Nauru and Ocean Island. Now Ocean Island is completely out of it, and they're looking around to make arrangements from other sources of supply. They've already begun to import some rock."

Another possible growth area, says Turbeville, is Canada. Considering the Russian grain shortage, the Soviets are going to need to import "a lot of grain from someone," he explains, "and they're surely going to give priority to Australia, Canada, and Ar-

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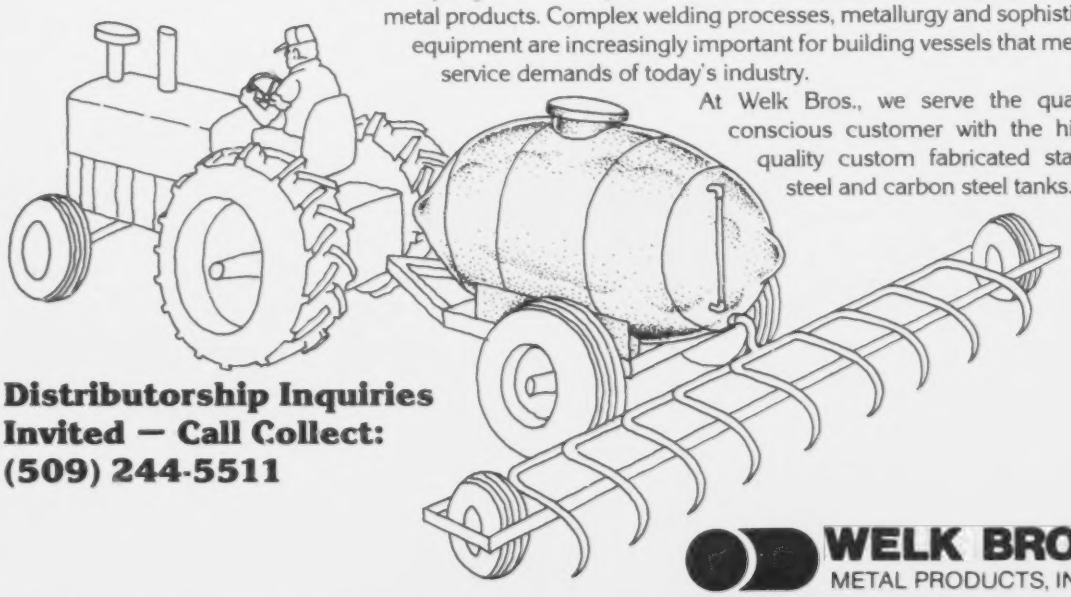

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gentina. As a result, I think the Australian and Canadian markets will offer us a little additional opportunity this year."

ICEC's Finley, on the other hand, sees no material change in the current export pattern. Conversely, he notes "certain patterns on a global basis. Certain raw materials are likely to be forthcoming at an increasing rate from African countries. I see Canada assuming a greater role in global trade of nitrogen, in addition to their role in sulfur and potash."

Either by choice or by policy, he feels the U.S. fertilizer industry has chosen to take a weak part in phosphate and possibly in potash exporting, and with the possible exception of certain proprietary fertilizers, he sees this continuing. But, he stresses, this should not be looked upon as a negative attitude.

"The fertilizer industry in the U.S. is largely predicated on domestic business. Our agriculture is of such magnitude and is so important that less importance has been attached to the export business," Finley explains. "This shouldn't be regarded as pessimism. It should be regarded as a matter of fact."

However it all turns out, at this point the industry can empathize with Turbeville's comment, "I'm looking for good news myself. If you hear any, let me know." FC

Soil Tests Can Ease High Production Costs

HIGH interest rates and increased production costs are causing North American growers to turn to soil testing more than ever as a way to combat inflated expenses by forcing them to look harder at long-range nutrient needs.

USDA agronomist Harold Owens takes an annual census of soil testing and plant analysis by both institutional and commercial labs. He found in 1979 that farmers, plant-food dealers, and others had invested in 3,034,000 soil tests—an increase of almost 10% over 1978.

Current figures are not yet available but word from several states and Canada indicates growers are using soil tests as a possible way around the cost-price squeeze, according to a report by Sperry New Holland.

"High prices of fertilizer are causing farmers to realize the importance of fine-tuning their fertilizer programs," says Jack Baird, Extension soils specialist at North Carolina State University. "Many farmers are even looking over their old soil test results to better determine their future fertility needs."

Alan Bandel, University of Maryland soil scientist, says they have been inundated with soil tests in Maryland as farmers try to cut costs. There is much more commercial lab work being done now, and fertilizer dealers are tending to use both commercial labs and university services to get the most accurate results.

Ohio State University soil scientist E. O. McLean calls the soil testing program used by universities a fertilizer "sufficiency" program. This, he explains, is aimed at getting a crop yield and a crop dollar that will more than pay for the last half-ton of fertilizer applied to the soil.

Most commercial soil testing labs use what is known as the BCSR (basic cation saturation ratio) concept. This is an "idealized relationship" of the soil's nutrient cations (positive ions).

A combination of the BCSR commercial lab concept and university "sufficiency" programs seems to work best as a basis for soil test interpretations in most conditions, McLean believes.

Peck feels commercial labs will play a larger role in soil testing as a service to farmers, and at least two states, Nebraska and Minnesota, have enacted legislation licensing and monitoring, to some extent, state soil-test lab operations.

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NATURAL GAS DEREGULATION— What Can We Expect?

Differences in natural gas prices between intrastate and interstate pipelines are already translating into differences in ammonia costs of from $35 to $50 per ton. With decontrol on the horizon, how will nitrogen fertilizer prices be affected?

OUTLOOK-

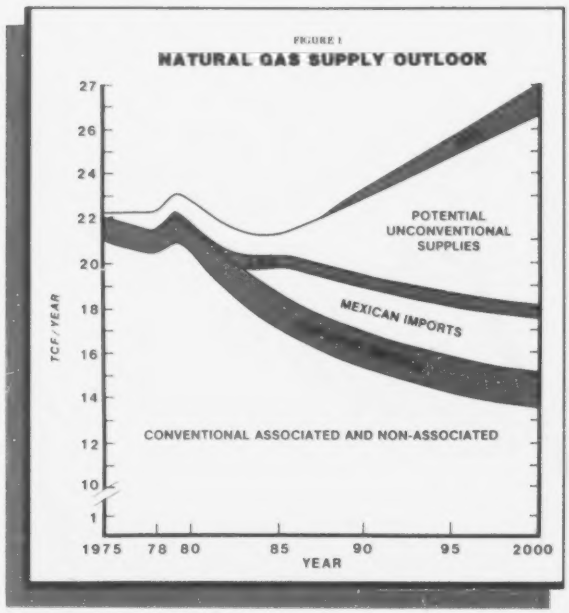
By J.R. DOSHER and D.L. BURTON

NATURAL gas feedstock and fuel represent roughly two-thirds of the cost of ammonia from a new facility. Diverging natural gas prices between interstate and intrastate pipelines and perhaps pressure from ammonia imports from Mexico, the Caribbean, and Russia have resulted in the shutdown of several ammonia plants recently. With current natural gas prices imposed by various price ceilings set in the 1978 Natural Gas Policy Act, differences in natural gas prices between interstate and intrastate pipelines are already as high as $1.00–$1.50 per million Btus, translating into differences in ammonia costs of about $35–$50 per ton. Compared to typical current ammonia prices of $150–$170 per ton, these differences are substantial.

The 1978 Natural Gas Policy Act already contains provisions for most natural gas supplies to rise in price to the equivalent of $16 imported crude oil by 1985. The rise in crude oil prices to the $35–$40 per barrel level during the 1979–1980 Iraq-Iranian war has made these decontrol schemes largely obsolete. Decontrol along this path would roughly mean a further doubling of natural gas prices in 1985.

Exactly how far and how fast natural gas prices will rise ultimately depends on natural gas supply and demand balances, and availability and

Mr. Dosher is president and Mr. Burton is vice-president of The Pace Company Consultants & Engineers, Inc., Houston, TX. Internationally known for its analyses of energy, Pace is currently conducting a study on the "Natural Gas Industry: Implications for the Future" to forecast supply, demand, and pricing of natural gas.



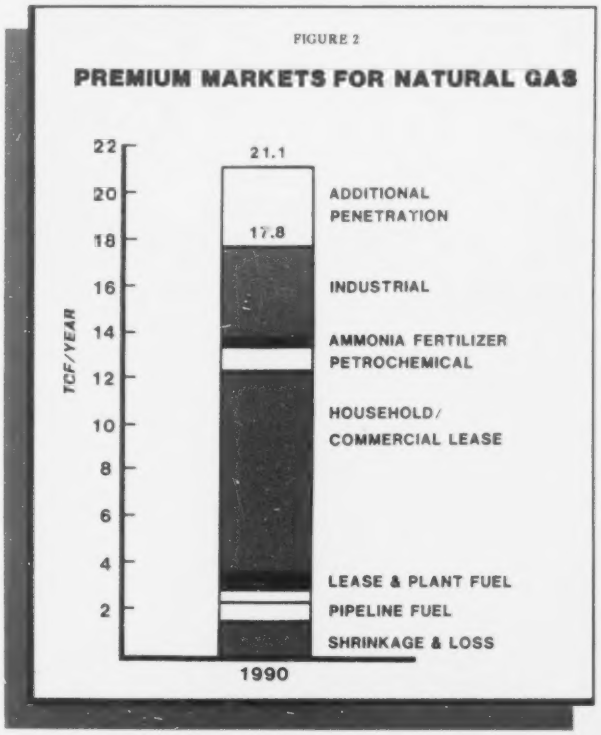
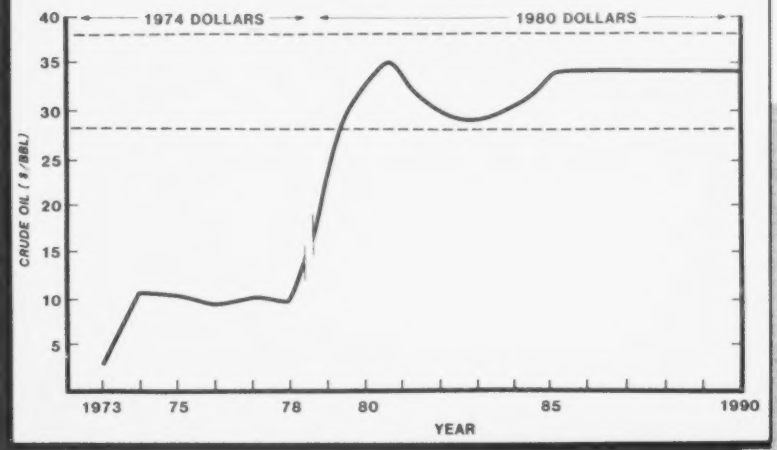


FIGURE 3

FOREIGN CRUDE OIL PRICES

DOLLARS PER BARREL



prices of competing fuels in important natural gas markets.

Supply/Demand Outlook

The gas supply outlook through 2000 is shown in Figure 1. Conventional associated and non-associated gas supplies will continue their downward trend. There are significant opportunities for overland imports from Canada and Mexico to contribute to supplies. Imported liquefied natural gas (LNG) supplies should remain roughly at their present level. For reasons discussed below, we have shown unconventional supplies as a range.

In 1990 we can see a fairly firm supply of 18–19 trillion cubic feet (TCF) per year. Unconventional supplies plus the Alaskan gas (ANS) could result in supplies as high as 23 TCF/year in 1990.

In addition to its use as a utility boiler fuel, natural gas has a number of premium uses. The forecast premium demands for gas in 1990 are presented in Figure 2. Premium demands are those uses where gas has a clear advantage over alternate energy sources or where the alternate is equivalent to or more expensive than distillate.

Ammonia production is clearly a premium use for natural gas. Roughly 0.7 trillion cubic feet of natural gas were used to produce ammonia in 1980. As shown, premium demands in 1990 are forecasted to be a minimum of 16.5 TCF/year and could go as high as 19.5 TCF/year with additional penetration in the household and commercial heating markets.

Thus, our forecast for 1990 calls for a close balance between the firm supply base and the premium demands. Additional supplies that might come from unconventional sources or Alaska could lead to total supplies being well in excess of the premium market. Gas markets would then be required in the non-premium utility power and large industrial markets where the alternate fuels are residual fuel oil or coal. The value of gas in these markets will be important in determining if these supplies will be developed.

FIGURE 4

NATURAL GAS PRICING

(CONSTANT 1980 DOLLARS)

	GULF COAST		EAST COAST	
	$/Bbl	$/MMBTU	$/Bbl	$/MMBTU
CRUDE OIL	34.00	5.80	34.00	5.80
RESIDUAL DIFFERENTIAL				
1.0 WT %S	(3.70)	(0.90)	-	-
0.3 WT %S	-	-	3.00	0.55
DISTRIBUTION	1.00	0.15	1.00	0.15
NET	31.30	5.05	38.00	6.50
NATURAL GAS EQUIVALENT		4.80		6.20
DISTRIBUTION		(0.10)		(1.10)
GULF COAST WELLHEAD		4.70		5.10

Price Outlook

A key factor in forecasting the price of residual fuel oil is the outlook for real crude prices. Based on an analysis of world crude markets and considering only economic factors, Pace believes that real crude prices (1980 dollars) will decline moderately through 1982 and then slowly increase to a median value of $34/barrel which will hold through the 1990s. Our forecast is shown in Figure 3. However, as illustrated by the recent assassination of President Sadat, political events in the Middle East could overwhelm economic factors, thereby leading to another increase in real prices.

The wellhead price for gas that is competitive with residual oil derived from $34 (1980 dollars) crude oil is shown in Figure 4. A price of $4.50–$5.00 per MMBtu is indicated. These economics would apply when gas competes with residual in an ex-

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FIGURE 5

NATURAL GAS ECONOMICS VS COAL IN POWER GENERATION (1980 $)

	DELIVERED MAXIMUM GAS PRICE	
	BASE LOAD	INTERMEDIATE LOAD
COAL AT $1.50 /MMBTU*		
BUILD NEW GAS vs NEW COAL PLANT	3.00	4.00
EXISTING GAS vs NEW COAL PLANT	4.00	5.00
COAL AT $2.00/MMBTU*		
BUILD NEW GAS vs NEW COAL PLANT	3.50	4.50
EXISTING GAS vs NEW COAL PLANT	4.50	5.00

*DELIVERED

DEMAND

MARKET	VOLUME , TCF/Y	PRICE, $/MMBTU
PREMIUM	17.0-19.0	6.00+
EXISTING GAS-FIRED BOILERS	3.8	4.00 to 6.00
NEW BOILERS	5.0	2.50 to 4.00

isting dual-fired boiler. Many gas-fired boilers have been adapted to use residual fuels because of fuel conversion projects undertaken after the 1973 Arab Embargo.

Gas is also competitive with coal under various conditions in power generation. For delivered coal prices in the range of $1.50–$2.00/MMBtu, the competitive gas price ranges from $3.00–$6.00/MMBtu on a delivered basis as shown in Figure 5. The equivalent wellhead price for the gas could be lower by $0.15–$1.00/MMBtu, depending on location.

In 1990 we expect a potential nonpremium gas demand of around 3.8 TCF/year in existing gas or dual-fired boilers. This market sector can support gas prices above $4.00/MMBtu with the major portion able to support prices above $5.00/MMBtu. Gas supplies above this level plus the premium demand would have to compete with coal in new facilities with competitive values as low as $2.50/MMBtu.

The preceding discussions support our opinion that gas has finite market increments with prices declining as volume increases. For 1990 these increments will be:

Market	Volume TCF/Y	Price (1980/$) $/MMBtu
Premium	17.0–19.0	6.00+
Existing Gas Fired Boilers	3.8	4.00–6.00
New Boilers	5.0	2.50–4.00

All of the prices discussed above are prices paid by the user. Due to the impact of decontrol and rolled-in pricing, the price obtained by the seller might be considerably different. Some new gas contracts have recently called for prices in excess of $8.00/MMBtu, and numerous contracts have been written with gas priced at a premium to distillate fuel oil. These prices can only be justified when averaged against cheaper controlled gas prices. There are almost no markets where the *wellhead* value of gas exceeds the heating value of distillate. **Ammonia prices based upon $8.00/MMBtu gas feedstock and fuel prices would be staggering at roughly $300 per ton.**

We believe the Reagan Administration is committed to complete decontrol, although a phased approach would be acceptable. However, we foresee other problems having higher priority for the Administration, and decontrol will not be pushed for several more months at best. Also, some members of Congress will probably advocate some form of continued control. Based on these factors, we predict that it will be a year or more before policies on gas decontrol are finalized. **In the meantime, disparities between gas prices between intrastate and interstate pipelines will continue to grow.**

The pressure to move toward decontrol has already been immense. Restrictions in the Fuel Gas Act of 1978 limiting the use of natural gas in utility and large industrial boilers have already been modified as part of the recent budget bill.

What's Ahead

What about the economics of future natural gas supplies? Alaskan gas will cost at least $10/MMBtu delivered to the United States. A wide range of costs have been estimated for the various sources classified as unconventional. Current industry interest is concentrated on deep (15,000 feet +) and tight gas. Conversations with companies active in developing these sources indicate that prices in the $5.00/MMBtu range are acceptable for investment commitments. This price might not be sufficiently cheap to fully develop these sources in a completely decontrolled environment. New supplies must compete with both residual fuel oil and coal in important markets.

We still believe that it will be extremely difficult to finance the Alaskan gas pipeline on the basis of passing these high costs on to consumers. The cost of deep and tight gas, however, appears to be in the competitive range. The final form of decontrol and additional development experience will determine the significance of these sources in the '90s.

But even as rising natural gas prices push ammonia prices higher, recent advances in genetic engineering might allow the creation of new wheat, corn, and rice crops which would absorb nitrogen directly from the air through nitrogen fixation. Dr. Frederich Ausubel of Harvard proposes to take nitrogen-fixing genes from bacteria that attach themselves to the roots of legumes and insert them into the genes of corn and wheat so they will have the ability to fix nitrogen from the air. If successful, these new crops would greatly reduce the demand for nitrogen fertilizers and would correspondingly reduce natural gas demand by some 0.5 TCF/year.

Developments of this type, along with the issues of decontrol and competitive fuel pricing, will require a continued assessment of natural gas supply, demand, and pricing over the next decade. **FC**

Agriculture 2000

What will agriculture be like in the year 2000? Experts say the answer depends on three major possible "breakthroughs"—photosynthesis enhancement, bioregulators, and twinning of beef calves.

Item: A gene that eventually might help various crop plants to withstand stresses, such as drought and high salt content in soils, has been isolated and shuffled from one bacterial species to another by scientists at the University of California, Davis.

Item: Several university researchers recently succeeded in making genes transfer into yeast cells. While yeast cells are very simple compared to those of crop plants, the transfer achievements could pave the way for *self-fertilizing crops.*

Item: Perhaps the most far-out food production idea now under study is the concept of cell-free agriculture. In this type of no-plant "farming," solar-powered reactors rather than living plant cells would convert carbon dioxide and water into food sugar. Plant physiologist Constantin Rebeiz has made it work on a small scale at the University of Illinois.

These and many more news stories were published the past year which give the impression that "Agriculture 2000" may be far different from what we are experiencing today. Is this a reasonable assumption or just a pipe dream? The answer FC editors received from participation in a recent USDA Workshop was "punctuated" by several "ifs, coulds, and mights."

FC was invited to help evaluate the prospects for on-the-farm adoption of a number of agricultural production technologies that "may emerge between now and the year 2000." The two-day "Technology Diffusion" Workshop was held this past November to aid USDA in establishing research priorities, develop long-range plans, and support decisions on budget requests.

WILL there be major technological breakthroughs in agriculture to stave off what world food experts envision as a major food famine by the year 2000? What new agricultural technologies are being studied by scientists? Which of these will have marked impacts on agricultural production?

These are leading questions that must be answered now, says the National Academy of Sciences. The prestigious group recently issued a study which states that the growing world population will require increases in agricultural yields averaging 2.5% per year over the next 25 years to double food production.

This appears to be "the impossible dream" unless we witness some unprecedented technological breakthroughs. USDA singles out as "the most promising new technologies (1) photosynthesis enhancement (formation of plant carbohydrates through exposure to light), (2) bioregulators (compounds which promote ripening or prolong shelf life) in crop production, and (3) twinning in beef cattle production.

What about genetic engineering which is receiving so much attention from the media—will it be a factor by the year 2000? The answer is that no one really knows. Genetic engineering ranked at the top of "emerging technologies likely to have the most impact on agricultural productivity by the year 2000" in a three-round USDA Delphi study involving 250 agricultural scientists starting in December 1980 and ending in July 1981. The study was entitled "Estimation of Future Food Productivity and Economic Impact."

"The Big Three"

Most researchers combine photosynthesis, nitrogen fixation, and genetic engineering as the three main agricultural technologies of the future under "photosynthesis enhancement." The first two have been singled out by researchers as having the potential for "unprecedented impacts on agricultural productivity," according to USDA.

Nitrogen fixation is a bacterial process by which nitrogen from the air is converted into a form the plant can use as a nutrient. The development of cereal crops that can draw on nitrogen in the air to meet an essential part of their fertilizer needs has been a long-time dream of agricultural scientists.

A group of researchers at Canada's Lethbridge, Alberta Research Station created a mild sensation recently when they altered a type of spring wheat so that it supports soil bacteria that can fix nitrogen taken from the air into a plant nutrient.

In photosynthesis studies at Connecticut Agricultural Experiment Station, scientists demonstrated that by blocking photorespiration, the net photosynthetic incorporation of CO_2 in many species could be increased at least 50%. Scientists long have known that the basic process involved in plant growth is photosynthesis and

now are closing in on a number of ways to increase the efficiency of carbon dioxide assimilation by crops and thus increase crop yields.

Another major area of research that rated high with scientists in the Delphi inquiry was plant growth regulators. Progress here is extremely slow, however, prompting Dr. Sylvan H. Wittwer of Michigan State University to criticize this area of research. He said there has been little effort to focus chemical growth regulator studies on significant food crop species—that most of the locally financed research in developing countries has been on plantation and export crops.

"The Limits of R & E"

Dr. Yao-chi Lu, agricultural economist with USDA's National Economics Division, provided some background on the limits of agricultural research and extension (R & E) at the beginning of the Technology Diffusion Workshop. Lu, who headed the USDA Delphi attended by FC this past November, did not paint an optimistic picture for the year 2000. Here is what he said about the possibilities of these futuristic systems:

"Most of these technologies would not be ready for adoption commercially until the 1990s. Furthermore, it takes decades to complete the adoption process.

"Their expected impacts on agricultural productivity in the year 2000 will consequently be small."

Lu has made an intensive study of technology as "the major long-run influence on productivity" and stressed that it is a slow and tedious process. Here is the way he explained it:

"Agricultural productivity could grow at 1.1% per year even without unprecedented technological breakthroughs if public funding of research and extension programs continues at its historical rate of 3% per year. (Lu referred to this as a 'baseline scenario.')

"Should real R & E expenditures increase 7% per year, but no unprecedented technological breakthroughs occur, agricultural productivity would grow 1.2% per year."

A group of Canadian researchers have altered a type of spring wheat . . . that can fix nitrogen taken from the air into a plant nutrient.

The latter is what Lu calls the "high technology scenario." These growth rates compare with a 1.5% annual growth in productivity over the last 50 years. Thus, without "unprecedented technological breakthroughs" productivity would probably continue to grow—*but at a slower rate.*

The researcher said that the above rate could be boosted to 1.3% per year by 2000 if we include the potentially unprecedented impacts of photosynthesis enhancement, bioregulators (compounds which promote ripening or prolong shelf life) in crop production, and twinning in beef cattle production, and if public investment in agricultural research and extension (R & E) increases 7% annually.

"The technological breakthroughs, coupled with a 7% real increase in R & E, could push productivity growth to or beyond its 1.5% historical rate if we extend the projection period to 2025," Lu reported.

He said he was "allowing for more time for widespread adoption of the breakthroughs whose impact by 2000 would be quite small."

He was also confident that should these technologies be usable earlier than the "average date scientists now predict," annual growth could reach or surpass 1.5% before the year 2000.

He hedged his forecast with the statement that "weather, in the short run, is the most important influence on agricultural productivity. During 1900–1972, variations in weather made productivity deviate noticeably above its normal level in one out of every three years. Such weather-induced annual variations in agricultural productivity growth will continue to grow," he warned.

The Top Technologies

Of the 50 "technology clusters" considered in the Delphi study, scientists "voted" on those which they felt have the greatest potential for the future. They also indicated the median estimate of the year in which commercialization is 50% likely and also the relative importance of each technology cluster on productivity, resources, and the environment. They finally settled on 14 technologies as having the "most impact." This information is included in Table 1.

When the Technology Diffusion Group met to define the barriers and

Most Important Emerging Agricultural Production Technologies
(As identified in the USDA Delphi study)

Technology Cluster	Median Estimate of Year In Which Commercialization Is 50% Likely	Relative Importance of Technology Cluster		
		Productivity	Resources	Environment
1. Genetic Engineering in Plants and Animals	1989	1	5	5
2. Water and Irrigation Management	1988	2	1	1
3. Plant and Animal Pest Control Strategies	1988	3	2	3
4. Minimum Tillage	1986	4	3	2
5. Biological Nitrogen Fixation	1988	5	7	6
6. Land Treatment for Soil Erosion Reduction	1988	6	4	4
7. Crop Residue and Animal Waste Utilization	1986	7	6	8
8. Enhancement of Photosynthetic Efficiency	1989	8	10	9
9. Multiple Cropping	1987	9	6	7
10. Soil, Water, and Plant Relationships	1988	10	9	10
11. Increased Animal Reproductive Capacity	1988	11	12	12
12. High Efficiency Pesticide Application	1988	12	11	11
13. Plant Growth Regulators	1987	13	13	13
14. Information Systems	1987	14	14	14

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other factors in the diffusion process, a group of 11 technology clusters based on the 14 studies by the scientists in the Delphi study were analyzed. They were (1) nitrogen fixation, (2) animal reproductive capacity, (3) animal genetic engineering, (4) plant genetic engineering, (5) photosynthesis, (6) water management, (7) plant growth regulators, (8) erosion/soil management, (9) multiple cropping, (10) animal pest control strategy, and (11) plant pest control strategy.

The following provides the recommendations of the scientists in earlier Workshops concerning these technology clusters.

Animal Genetic Engineering

This technology cluster originally embraced genetic engineering for both animals and plants in the Delphi study. As such, it ranked at the top in potential impact on agricultural productivity. It also ranked fifth in having a positive impact on natural resource utilization and fifth in increasing environmental quality.

The line of research judged to be most promising was animal pharmaceuticals (antibiotics, monoclonal ab, interferon, growth and analgesic hormones, enzymes, vaccines). Other lines receiving votes were increased animal resistance to pests, increased animal growth efficiency by means of hormones, conversion of waste animal biomass to energy, and engineering animal pests.

Plant Genetic Engineering

In addition to ranking first (along with animal genetic engineering) in potential impact on agricultural production, plant genetic engineering ranked fifth in positive impact on natural resource utilization and fifth in increasing environmental quality. Increasing plant resistance to herbicides, pests, drought, salinity, fungal toxins, bacteria, rusts and viruses was the line of research judged as most promising.

Other research lines regarded highly were increased plant growth efficiency by means of improving nitrogen fixation and photosynthesis, engineering plant pests, and conversion of plant biomass to energy.

Water Management

Ranking second in potential impact on agricultural productivity, this technology cluster also ranked first in increasing environmental quality, according to Delphi researchers. "Achieving soil-water optimization for plant growth" was judged as the most promising line of research, followed by improved water and energy conservation, enhanced water supply by means of weather modification, management, improved drainage of heavy soils, and development of systems for interbasin water transfers.

Animal and Plant Pest Control

New pharmaceuticals that can be more effectively applied, are safer, and leave fewer residues was the line of research considered most highly by researchers in the USDA Delphi animal and plant pest control technology cluster. Along with increased host resistance (genetic and immunological), genetic engineering of pest populations, biological controls for predators, parasites, competitors, and pathogens, pest control technology was considered to have "great potential."

Researchers indicated that feed efficiency of beef, pork, and poultry would rise by 13%. They estimated that a 12% rise in pounds of milk per cow could be realized and a 17% improvement in the state of water quality.

Researchers forecast crop yields could be increased from plant pest control as follows: cotton-12%; wheat, corn, and soybeans-10%. A major increase (17%) in efficiency of fossil fuel use was also projected.

"Unlike conventional production, the business of producing technologies is a long, risky process."

—Dr. Yao-Chi Lu, USDA

Erosion Control/Soil Management

The line of research considered as most promising for erosion control/soil management was "improved erosion control practices—especially conservation tillage." Researchers estimated that this type of technology could increase production in wheat by 11%, corn by 12%, and soybeans by 9%.

Other important lines of research were improved erosion assessment, reclamation of eroded land, development of organizations and policy for greater conservation implementation, improved soil management, and engineering crops to improve soil quality.

Nitrogen Fixation

The most significant effect forecast by the group as a whole is that this technology could increase the efficiency of fossil fuel use by 106%. Also noteworthy is that neither the group as a whole nor the "more expert and confident subgroup" judged that this technology would have any important effects on productivity. The line of research judged to be the most promising was "new catalyst and system for small-scale production of nitrogen fertilizer."

What's the practicality of such a system? A scaled-down electric-arc system for atmosphere nitrogen fixation that was displaced over 50 years ago by the Haber-Bosch process is now under review, according to Dr. Sylvan Wittwer, director of Michigan State University's Experiment Station.

"The farm size unit has the potential of making even the poor small farmer self-sufficient in nitrogen fertilizer," Wittwer reports. "This unit could be inexpensive and easy to operate and maintain. It would utilize nitrogen from the air, and a modest electric current from a generator powered by wind, water, or sunlight freely available on a farm." Wittwer added that it is now being tested on a farm in Sandpoint, ID, "and in Nepal with its plentiful supply of fast-flowing water and very little nitrogen."

Photosynthesis

The line of research judged to be most promising in photosynthesis technology was increased efficiency of CO_2 fixation by plants, far outstripping the others—increased leaf growth and persistence (delayed senescence); reduced sensitivity to cold stress; increased rate of ATP, NADPH formation; and reduced sensitivity to heat stress (H_2O splitting).

Multiple Cropping

Reduced tillage coupled with improvement in herbicide efficiency was far and away the leading line of research in this technology cluster. Others were improved winter legumes for N_2 production, improved crop varieties for multiple cropping, and development of real-time data systems for information on moisture and heat stress.

Animal Reproduction

This technology cluster ranked 11th in potential impact on agricultural productivity. In the Delphi study, the line of research judged to be most promising was gamete and embryo manipulation, far outstripping the others—improved male potency, decreased generation interval, increased control of reproductive disorders.

Plant Growth Regulators

There's no question that researchers see plant growth regulators as a major area for impact on productivity. The line of research judged as most promising was "regulators that enhance yields." This was followed by regulators that ameliorate stress (biological and environmental), regulators that conserve water (nutrients and energy), and crop management utilizing all the technologies mentioned.

Researchers forecast that plant growth regulators would increase production by 19% in wheat, 13% in corn, and 18% in soybeans. They

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would have a "modest effect," however, in improving efficiency of natural resource use.

Diffusion Can Be Confusing

When the Technology Diffusion Group studied the various barriers that may affect the acceptance of the emerging technologies, the participants had many things to consider. First of all, as Lu said, "technological change does not occur automatically." Investments in research and development are needed. And, unlike conventional production, the business of producing technologies is risky.

"Standard" barriers to adoption of a new technology consists of such things as (1) initial capital requirement, (2) "belief in ability to achieve the 'production promise'," (3) educational requirements of the users, (4) educational requirements of the educators, (5) environmental restrictions, and (6) "useful life" of the technology. But there are many others.

The Group determined that with the 11 emerging technologies it studied, belief in ability to achieve the "production promise" was the most formidable barrier. Taking a close second was initial capital requirement. In third place was inadequate packaging and distribution. Further down the line were educational requirements of the users, educational requirements of the educators, and resistance to change. The latter is becoming less of a factor as the result of fewer but more knowledgeable producers.

Recommendations made by the Group for overcoming these barriers in the future were numerous with the following getting the most votes:

(1) Provide more farm level economic studies.

(2) Report research information in an "engineering sense."

(3) Integrate state-federal research and extension efforts.

(4) Involve growers in the early stages of agricultural policy-making – both at the federal and state levels.

(5) Encourage more interdisciplinary research and extension programs.

(6) Provide increased training and learning opportunities for extension staffs—allow for more contacts with other specialists across the nation.

(7) Pay attention to outside oversight on research/extension at both federal and state levels.

(8) Develop a "Voice of Agriculture" program to reach consumers at all levels.

Results of the Technology Diffusion Workshop will be available in the near future and will include recommendations for funding of research and extension programs. Hopefully, the workshops conducted by USDA during the past two years will help that agency structure its budget decisions and improve its performance in forecasting emerging technologies and establishing policies.

The leading question remains—will the public support what USDA feels is essential for future research and extension funding or will it respond by claiming that "Washington is crying wolf"?

We are all a part of that answer. The future is up to how we all "vote" on the importance of the emerging technologies—not just the scientists who took part in the historic USDA Delphi process. **FC**

Outlook Hopeful as Block Favors Research

REPEATED statements by Secretary of Agriculture John R. Block that he considers research and Extension "high priority items" have made landgrant agricultural college administrators confident that their part of USDA's budget won't suffer too much from cuts. "But," cautions Dr. William P. Flatt, "we *are* in an austerity era now."

Director of the University of Georgia's agricultural experiment station and veteran advisor on federal budgetary matters concerning agriculture, Flatt explains that an unusual and rare situation has occurred. At this writing the 1982 budget has not been approved and is literally "back on the drawing board." In most years, says Flatt, "The Conference Bill produced by agreement of the House and Senate contains the figures that would be our appropriation. But this year the bill was vetoed by the President."

Suggested appropriations for research, teaching, and Extension for fiscal year (FY) 1982 stood at 9–11% above FY '81, even though USDA's total budget suffered a $1½ billion cut.

Total research, which Flatt explains includes the 1890 Colleges appropriation, competitive research grants, animal health, and several other special items, received $202,897,000 in FY '81 and a proposed $225,548,000 for FY '82, an increase of approximately $24½ million. The Cooperative Extension Service, or the Smith-Lever formula funds, received $205,448,000 in FY '81 and a proposed $223,376,000 for FY '82, roughly an $18 million increase. The figures for the Hatch Act portion of the Cooperative State Research Services (CSRS) appropriation ran $128,650,000 in FY '81, $143,609,000 for FY '82. The total for all special items in the Extension Service area (1890 Colleges, pest management, farm safety, etc.) received $303,769,000 in FY '81, a proposed $302,702,000 for FY '82.

By how much does Flatt expect these figures to change? "The figures will be reduced," he surmises, "but how much I don't know. I expect it will be probably somewhere in the range of 5%."

The area that will suffer the most—in fact, it has been obliterated and is not expected to be reinstated—is Bankhead-Jones. Listed in the teaching area of the budget and earmarked for higher education, this appropriation ($11½ million in FY '81) was awarded to the landgrant universities to finance special enrichment courses in the colleges of agriculture. Its deletion was no surprise. Actually, says Flatt, "The Office of Management and Budget has traditionally left it out. It's been up to Congress to put it back in. This time they didn't."

How serious a loss is this? For 80% of the universities, the money was absorbed into their total budget. The remaining 20%, located mainly in the Northeast, sent it directly to their college of agriculture for apportioning. "They are the ones that will be most affected if Bankhead-Jones is completely done away with," Flatt asserts. However, he points out that even with this area's $11½ million deletion, the teaching portion of the budget received a proposed $17 million increase.

Although the 1982 budget has not been approved, Flatt and others are in the process of planning their part of the 1983 USDA budget. "In fact," he explains, "there's already a committee working on the FY '84 budget. We're always planning ahead. We work on the basis of continuing resolution, assuming that we'll have as much money for the coming fiscal year as we did for the last. I guess it varies from state to state how much directors rely on projections, but we have to plan ahead in preparing our budgets." Plan and cross their fingers in this age of economic and governmental unpredictability. **FC**

OUTLOOK-

This is the Year For Creative Marketing

Overall indications for depressed farm chemical sales this crop year will leave the largest share of the market to those dealers with the most innovative customer programs.

By BRUCE A. SHERR

Dr. Sherr is president and chief executive officer of Agri-Commodities, Inc. (ACI), an agribusiness consulting firm in North Andover, PA. He directs overall company activities by actively participating in agribusiness and consulting and commodity programs. An internationally recognized agricultural economist, he has worked with major pesticide manufacturers in evaluating product marketing strategies and the impact of agricultural economic factors on industry/company performance.

THE 1981/82 crop year represents a formidable challenge to the marketing creativity of the farm chemicals industry. The current crop year is characterized by large available supplies of grains, oilseeds, and fibers; a poor general economic outlook; and difficult financial times for the farmer. Articles of this type usually attempt to highlight areas of risk and opportunity in a dynamic and volatile agricultural economic environment; however, the current crop year looms not so much as dynamic or exciting, but dull and depressed by crop supplies well in excess of demands.

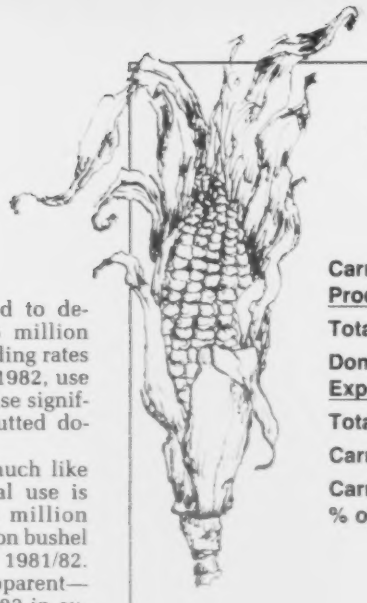
A strong case can be made, when considering several key indicators, for weak farm prices and generally poor farm incomes in the 1981/82 crop year:

- In 1981 U.S. farmers harvested large crops as the productive genius of American agriculture, coupled with very favorable weather conditions, resulted in all-time record corn, wheat and cotton crops and a near-record soybean output.
- These large new crops were added to already large domestic inventories of grains and oilseeds carried over from the 1980/81 crop year.
- The world production of crops in 1981 was quite good with the exception of a less than targeted Soviet grain crop and a short Indian rice output, suggesting only modest changes in U.S. export volumes for 1981/82.
- Crop prices in the 1981/82 crop year should be constrained by a weak general economy as even the most optimistic Reagan Administration estimates suggest a mere 1% growth rate for the real Gross National Product.
- Interest rates have dropped in recent months, but relatively tight money policies should serve to constrain economic expansion and demands in 1982.

Factors Shaping 1982

A significant indicator of a relatively weak agricultural economic outlook in 1982 is found in the stock-to-disappearance ratios for each major crop. The record production of major grains, oilseeds, and cotton in 1981 is the foundation for an economically weak U.S. farm sector. Even with strong export demands, the farm situation is characterized as one of large domestic supplies.

The demand outlook for feed grains and oilseeds is rather modest, as 1981/82 exports of corn are expected to exceed the last crop year's by only 12 million bushels. This factor coupled with a declining base for domestic livestock feeding will lead to an all-time record carryout of corn of roughly 1.8 billion bushels. The number of grain consuming animal units on U.S. farms has declined from 481 million in the 1979/80 crop year to approximately 470 million in 1980/81, and



these numbers are projected to decline further to about 456 million units in 1981/82. Even if feeding rates per animal unit increase in 1982, use of feed grains will not increase significantly, exacerbating the glutted domestic feed grain markets.

The soybean outlook is much like the feed grain forecast; total use is projected to advance 138 million bushels relative to a 241 million bushel increase in total supply for 1981/82. The bottom line is all too apparent—a carryout of soybeans in 1982 in excess of 400 million bushels.

The cotton outlook indicates a considerably excessive supply relative to demands. The record 15.6 million bale (480 pounds) crop in 1981 turned an otherwise relatively tight cotton situation completely around. The projected supply/utilization for cotton is shown in Table 2. At current prices exports would reach the 6.5 million bale level in 1981/82 and domestic mill use would decline in a recessed domestic economy. Even with a 5.6% increase in total use, supplies will exceed demands by an extraordinary 6.1 million bales.

Cotton use in 1982 should be constrained by a very weak general economy as housing starts and new car sales remain very depressed. Furthermore, the outlook for the textile industry in general is weak. Nonetheless, the figure to key on is exports, which are over 2.7 million 480-pound bales below the level of 1979/80. It is likely that cotton producers will utilize the Commodity Credit Corporation to absorb about 20–30% of the available cotton by early 1982. This factor will serve to support current prices which are near the loan rate of 52.5 cents per pound.

Acres Planted in 1982

New crop plantings, a singularly major indicator for the agricultural chemical industry, will not adjust very much from last year's levels. Wheat seedings in the fall of 1981 are expected to remain strong as wheat is the only major U.S. produced grain with a generally bullish price outlook. It is likely that corn and soybean plantings will remain, respectively, at about the 84 and 68 million acre levels of 1981 and cotton plantings are expected to decline below 14 million acres.

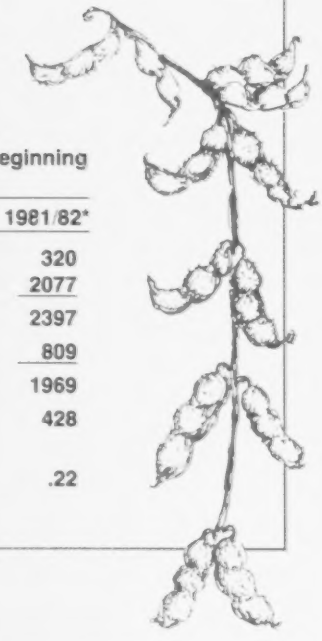
A simplistic analysis of the relative prices for corn, soybeans, and cotton

TABLE 1
SUPPLY/UTILIZATION FOR CORN AND SOYBEANS, U.S., MILLION BUSHELS

	Corn, Crop Year Beginning Oct. 1		
	1979/80	1980/81	1981/82*
Carryin	1304	1617	1034
Production	7939	6648	8097
Total Supply	9243	8265	9131
Domestic Use	5215	4942	4956
Exports	2411	2353	2365
Total Use	7626	7295	7321
Carryout	1617	1034	1810
Carryout as a % of Total Use	.21	.14	.25

	Soybeans, Crop Year Beginning Sept. 1		
	1979/80	1980/81	1981/82*
Carryin	174	359	320
Production	2268	1792	2077
Total Supply	2442	2151	2397
Exports	875	724	809
Total Use	2083	1831	1969
Carryout	359	320	428
Carryout as a % of Total Use	.17	.18	.22

*Projected



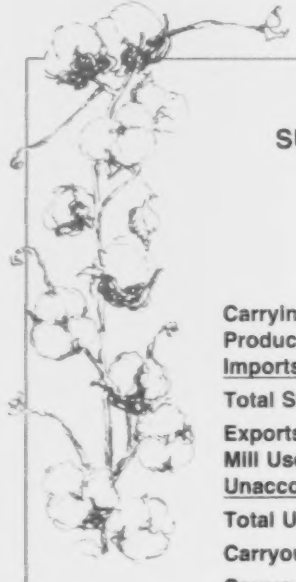


TABLE 2
SUPPLY/UTILIZATION FOR COTTON, THOUSAND, 480 LB. BALES

	Cotton, Crop Year Beginning Aug. 1		
	1979/80	1980/81	1981/82*
Carryin	3958	3000	2668
Production	14029	11122	15560
Imports	5	27	5
Total Supply	18592	14149	18233
Exports	9229	5926	6500
Mill Use	6509	5891	5825
Unaccounted	−143	−336	−200
Total Use	15592	11481	12125
Carryout	3000	2668	6108
Carryout/Total Use	.19	.23	.50

*Projected

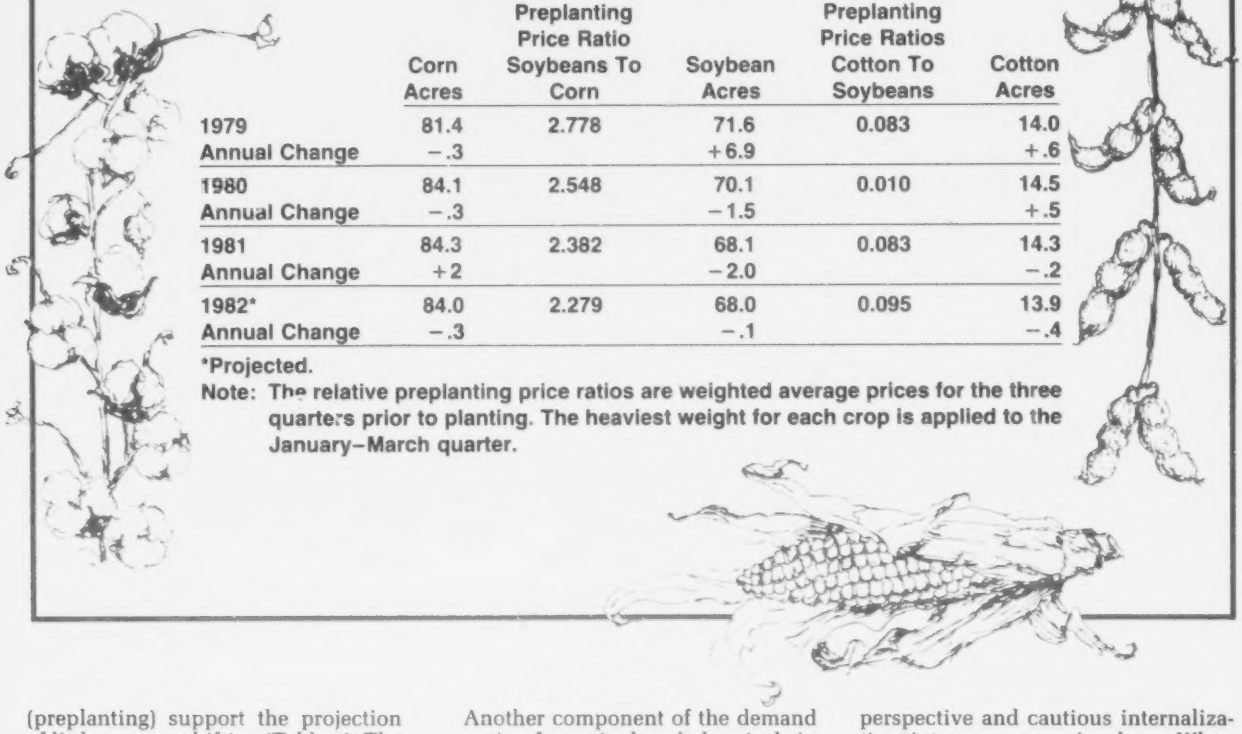
TABLE 3

ACRES PLANTED TO SELECTED MAJOR CROPS, MILLIONS OF ACRES AND REPLANTING PRICE RATIOS OF COMPETING CROPS, 1979–1982

	Corn Acres	Preplanting Price Ratio Soybeans To Corn	Soybean Acres	Preplanting Price Ratios Cotton To Soybeans	Cotton Acres
1979	81.4	2.778	71.6	0.083	14.0
Annual Change	−.3		+6.9		+.6
1980	84.1	2.548	70.1	0.010	14.5
Annual Change	−.3		−1.5		+.5
1981	84.3	2.382	68.1	0.083	14.3
Annual Change	+2		−2.0		−.2
1982*	84.0	2.279	68.0	0.095	13.9
Annual Change	−.3		−.1		−.4

*Projected.

Note: The relative preplanting price ratios are weighted average prices for the three quarters prior to planting. The heaviest weight for each crop is applied to the January–March quarter.



(preplanting) support the projection of little acreage shifting (Table 3). The farmer has every incentive to produce at full capacity, even in light of current and projected weak prices. Farm programs, particularly the long-term grain reserve, coupled with Commodity Credit Corporation programs should serve as a cash flow and price safety-net for producers. Therefore, even as prices for all major crops are weak, but underpinned by Federal programs, acreage planted in 1982 should remain at historically high levels.

The federal government has passed the dates by which a feed grain acreage reduction program could be initiated. Furthermore, such actions are an unlikely policy move by the Reagan Administration. The provisions of the grain reserve should enable the federal government to carry additional inventories from another high production experience in 1982. Experience suggests that, unless the government provides adequate incentives to remove acreage from production, it just would not happen. It is still in a farmer's interest to plant to full capacity and achieve the highest receipts possible from his land. These factors establish a strong case for the willingness of farmers to allocate full resources to planting major crops in 1982.

Another component of the demand equation for agricultural chemicals in 1982 is the farmers' ability to buy. It is fortunate for the chemical industry that chemicals are almost as important as seeds. However, in terms of ability to buy, in periods of poor economic conditions and difficult financial times, farmers can be expected to show cost sensitivity. This sensitivity to cost will manifest itself in the agricultural chemicals business in several ways:

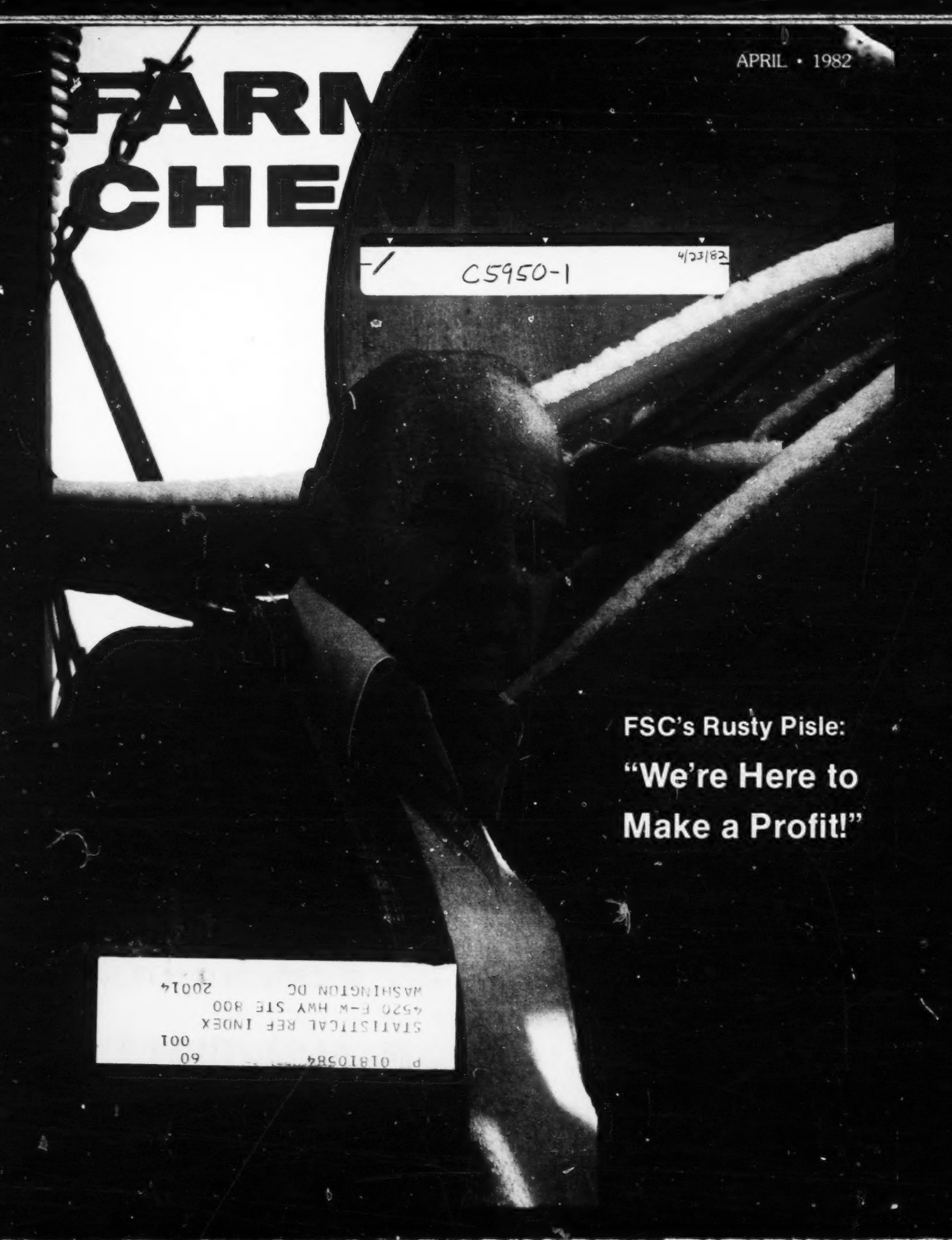
* Farmers will shop for prices where suitable substitutes are available;
* Purchase decisions might be delayed;
* Application rates and treatments could be reduced as farmers choose to take more production risks and reduce costs;
* Farmers might shift some acreage to crops which have a lower variable cost of production; and
* Farmers will be responsive to chemical marketing programs, particularly cost rebates, which place dollars directly in their hands.

Managing the Risks

An outlook discussion is an imprecise statement of a potential future. Outlook analysis requires a proper perspective and cautious internalization into a company's plans. When dealing with agriculture, one must continue to focus on those key areas which can catalyze change. This suggests that, in the development of strategy and tactics, the agricultural chemical industry should consider alternative forecasts or scenarios. This is accomplished, most successfully, by leveraging on the "knowable."

All too often plans and programs are based on issues for which risks cannot be calculated or assessed. These are situations of uncertainty and immediate examples come to mind, such as, 1982's expected weather, the 1982 Soviet crop, and other unpredictable factors.

As we begin 1982, the major areas of risk which require the industry's attention are those which each firm can control or respond to individually. These factors are centered around each firm's marketing programs. The agricultural economic market environment from this moment up through spring planting is all too clear—depressed. Nonetheless, the industry can expect another year of historically high acreage. The challenge to each agricultural chemical firm for 1982 is to effectively meet its competition with inventive and novel product marketing programs. **FC**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THE COVER STORY

This month we revisit Rusty Pisle of Farm Service Center, Spencerville, OH—a dealer who was featured on our cover in 1973. Since then, his sales have risen 15-fold due to remarkable business acumen, innovation, technological advancement, and—basically—just keeping up with the times. His updated story begins on page 13.

BPA MEMBER BUSINESS PUBLICATIONS AUDIT

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expressed the view that this provision "is appropriate and important," one thought it should be terminated by a stroke of the "congressional guillotine," and one made no comment upon the disposition of the provision. All agreed, however, that the provision has not proved useful thus far.

The comments reviewed in these excerpts, though written in the present tense, refer mostly to the past, where the EPA is concerned. Developments associated with the change in administration after the hearing are not necessarily reflected.

Copies of Special Publication No. 9 are available upon request to individual CAST members. The publication is being distributed to EPA and institutional members of CAST.

Monte Carlo Model Analyses Aerial Drift

MODIFICATIONS in a laboratory model designed for analyzing aerial drift may provide a useful tool for designing agricultural spray rigs and flight procedures as well as establishing criteria for developing methods of application and targeting practices.

Walter Frost and Kao-Huah Huang of FWG Associates, Inc. have developed the Monte Carlo particle dispersion model (MoCaPD) with two features not found in current models. They provide the ability to predict a given particle size distribution and/or number density as a function of time and spatial position; and the ability to account for the characteristics of the nozzle or method of particle release.

In a paper presented at the 1981 winter meeting of the American Association of Agricultural Engineers, Frost and Huang described the basic model concept as consisting of plotting the time histories of various random particle trajectories related to a fixed coordinate system. The random functions of position and time, and of prevailing meteorological conditions are stored in a data file and used to carry out statistical analyses or "real-time" simulations.

A particularly unique feature of the model is the capability to account for the source characteristics. The nozzle particle output characteristics are inputs to the MoCaPD computer program. Thus, parametric studies of source particle size distributions, method of particle ejection, etc. are possible. At present, the model assumes the particle size remains constant along its trajectory. The potential for modeling condensation/evaporation, nucleation, coagulation, and inter-particle force effects along the trajectory exists.

Simulations, using the model, represented particle dispersion from an aircraft with the characteristics of a Marsh Turbo Thrush outfitted with hollow cone disk-type TEEJET nozzles having a flat fan 8015 nozzle tip spray system. Eight nozzles located along the wing span were assumed. This nozzle has a 3/32-inch orifice diameter and an 80° spray angle at 40 psig. With insecticide applied at a rate of 1.5 gallons/minute, the exit velocity from the nozzle is approximately 12 meters/second. The initial velocity of the droplets exiting the nozzle was thus assumed to be 12 meters/second.

Flight conditions assumed for the simulation were level flight at 1.5 meters above the ground with two crosswind conditions. For these conditions 100 particles each of 10, 18, 40, 80, 133, 160, and 300 microns, respectively, were released from each of the eight nozzle locations. The probability of a particle of given size landing at a prescribed position on the ground (that is, within 1-meter intervals perpendicular to the flight path) was computed. Turbulence levels corresponding to the mean wind speed and a surface roughness length scale of 0.01 micron were superimposed upon the mean vortex wind field created by the aircraft. The flat fan nozzle tip was assumed to be pointing downward with the two-dimensional spray pattern perpendicular to the centerline of the aircraft.

Comparison of the model with experimental measurements reported in other literature shows good agreement between theory and field test. Frost and Huang therefore concluded that the improved unit provides a valid technique for analyzing the effects on chemical spray applications of:

- Flight path and prevailing wind direction;
- Meteorological measurements of temperature gradient, wind profile, relative humidity, etc.;
- Type and amount of adjuvant;
- Nozzle type, size, position, and distance from nozzle to target;
- Drop size distribution at the nozzle and on the ground; and
- Physical properties and quantity of active ingredients.

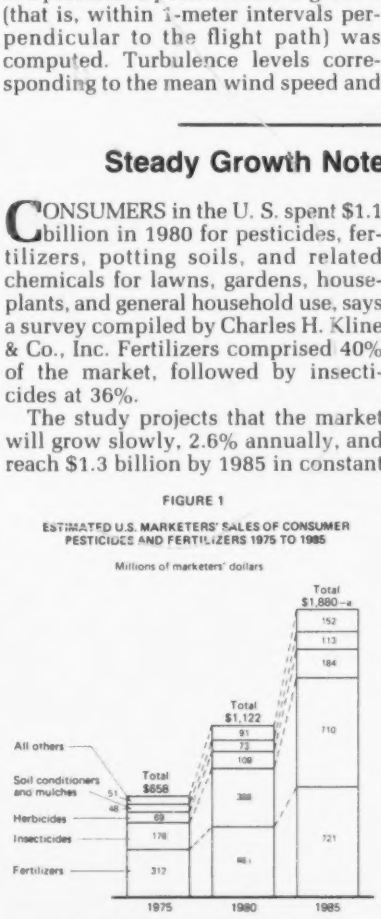
Steady Growth Noted in Home Use Survey

CONSUMERS in the U. S. spent $1.1 billion in 1980 for pesticides, fertilizers, potting soils, and related chemicals for lawns, gardens, houseplants, and general household use, says a survey compiled by Charles H. Kline & Co., Inc. Fertilizers comprised 40% of the market, followed by insecticides at 36%.

The study projects that the market will grow slowly, 2.6% annually, and reach $1.3 billion by 1985 in constant dollars. Sales of household and outdoor insecticides are expected to increase most rapidly.

FIGURE 1

ESTIMATED U.S. MARKETERS' SALES OF CONSUMER PESTICIDES AND FERTILIZERS 1975 TO 1985



a – Assumes an average annual inflation rate of 8.0%

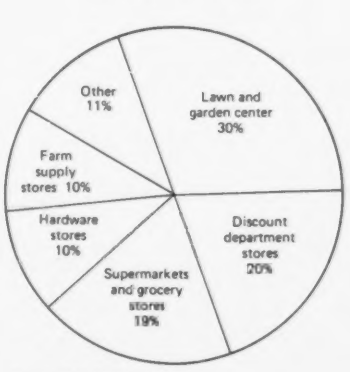
Source: *C.H. Kline and Co.*

The study found that three companies dominated the overall market in 1980 with a 31% share: Chevron's Ortho Division controls the largest share in outdoor pesticides; S. C. Johnson & Son in household insecticides; and O. M. Scott in lawn fertilizers. Most of the remaining business was split among about 250 small, regional companies, although it was noted that several larger companies have made inroads through acquisitions or private labeling.

The Kline study, a revision of a 1976 survey, is available in two volumes, one centering on business analysis and the second on consumer/retailer profiles. 1006 pages in total, they are based on 1710 interviews. Further information on *Consumer Markets for Pesticide and Fertilizers 1981* and/or a companion survey, *Professional Markets for Pesticides and Fertilizers*, is available from C. H. Kline & Co., 330 Passaic Ave., Fairfield, NJ 07006.

FIGURE 2

ESTIMATED U.S. MARKETERS' SALES OF CONSUMER PESTICIDES AND FERTILIZERS BY RETAIL OUTLET 1980



Source: *C.H. Kline and Co.*

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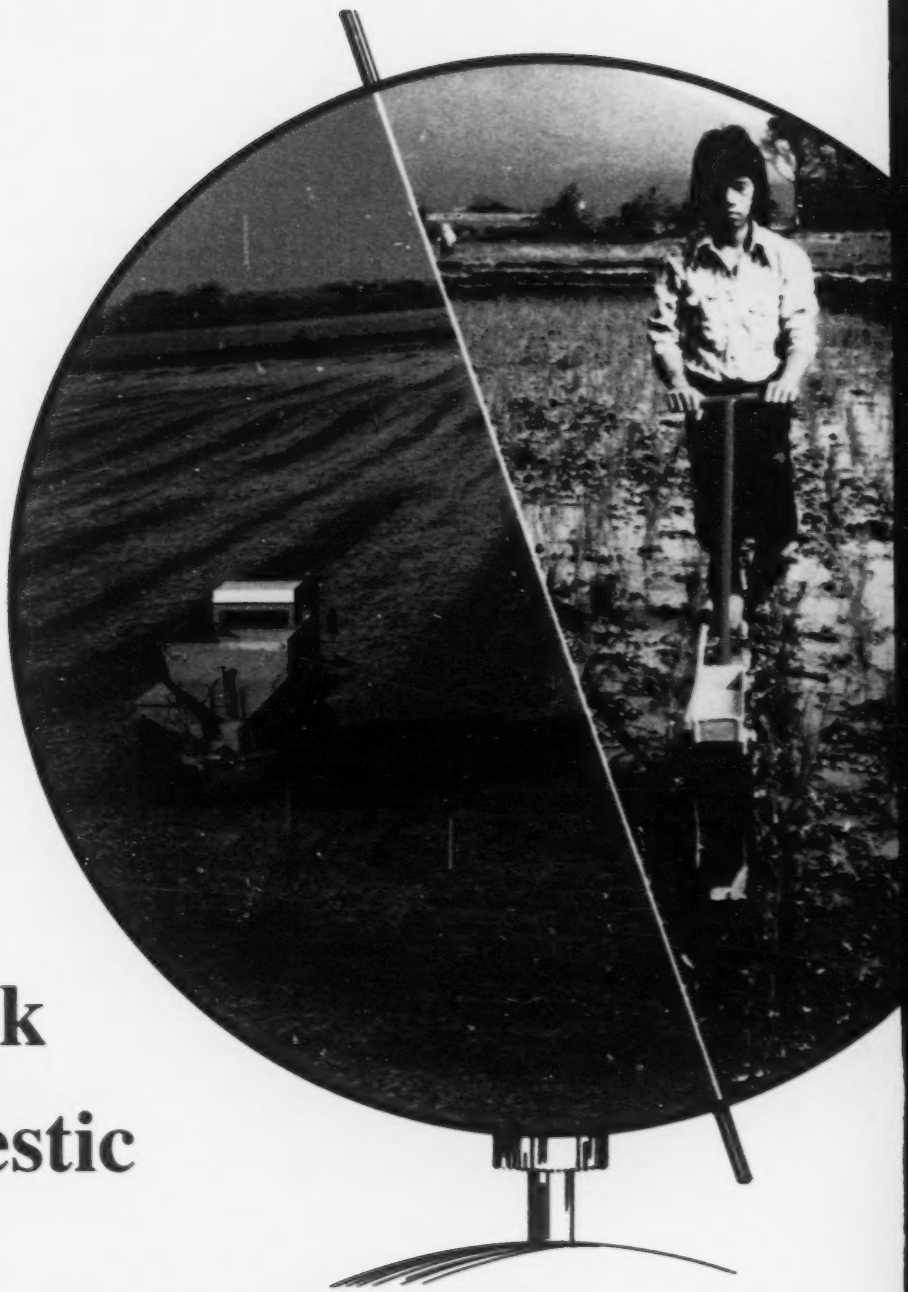


You Can't Think Only Domestic

Whether you're retailing fertilizers for application in Indiana or India, it will pay you to know how much fertilizer is being used in your country—and outside.

Action in world fertilizer markets not only affects those businesses which ship to or buy from foreign firms, but retailers as well. As international trade in fertilizers intensifies, knowing conditions in the world fertilizer market will help you to make good purchasing decisions.

By EDWIN M. WHEELER

World Nitrogen Markets Soar. As Dollar Rises, Foreign Buyers Back Off. Export Buyers Bullish on U.S. Phosphate Rock Purchases. Saskatchewan Potash Push Is On. Morocco Plans Phosphate Expansion.

Such headlines occur almost daily in U.S. fertilizer industry publications, but those mainly affected by such developments are the import/export companies and fertilizer producers. Right?

Not necessarily, particularly in the U.S. market where imports of potash provide about three-fourths of our domestic use and where exports of phosphates approach 40% of our production.

Action in world fertilizer markets affects not only those U.S. businesses which ship to or buy from foreign firms, but U.S. retailers, as well. These developments can send ripples . . . or tides . . . through the entire industry.

Diammonium phosphate, anhydrous ammonia, muriate of potash and most other fertilizer products in the U.S. retail inventories are marketed throughout the world. They are international commodities, much like grain and coal. As international fertilizer markets ebb and flow, so do value and availability of products to U.S. fertilizer retailers, whether in California or Georgia.

By the same token, fluctuations in the U.S. commodity market for grains and oilseeds influence not only the market for fertilizers in the U.S., but around the world, since the U.S. is the largest producer of farm products—and the largest single market for fertilizers, as well.

What does this mean for the U.S. fertilizer retailer? Many retailers already know the answer. They are the ones who watch U.S. import/export trends. They are the retailers who are aware of market calms and swells in overseas fertilizer production and demand. And they are the retailers who are ready to take advantage of the market when conditions are best for them.

An example of world trade influences on U.S. fertilizer production is easily seen in the phosphate rock trends shown in Figure 1. U.S. rock production has grown from 29 million tons in 1969–70 to 62 million in 1980–81, while exports have climbed from 11 million to as high as 17 million in 1979–80 with a drop back to 14 million in 1980–81. This decline has continued in the current year, and has meant growing inventories of phosphate products in the U.S. and growing frustration for U.S. phosphate producers. The result, of course, has been market fluctuations here and in other countries and drastic production cuts at U.S. facilities.

Export and production of U.S. finished phosphate materials, such as the ammonium phosphates, although showing improvement throughout the 1980–81 year, also have begun to follow the export decline of phosphate rock in recent months. And, once again, the influence of world market action is reflected in domestic markets as well. But, as Figure 2 illustrates, the export market for these products has advanced in lock step with production of phosphoric acid through the 1981 fertilizer year.

Import Shifts

Every retailer is aware that the U.S. farmer is dependent upon sources outside our borders for about 75% of U.S. potash fertilizer supplies. The bulk of this tonnage is imported from Canada, but other countries, such as Israel, Spain, East and West Germany, Russia, and Britain, also provide the U.S. with potash.

This net import position for potash has existed for more than 20 years, since 1962.

A much more recent development, shown in Figure 3, is the gradual trade balance shift in U.S. import and ex-

Mr. Wheeler is president of The Fertilizer Institute, Washington, DC.

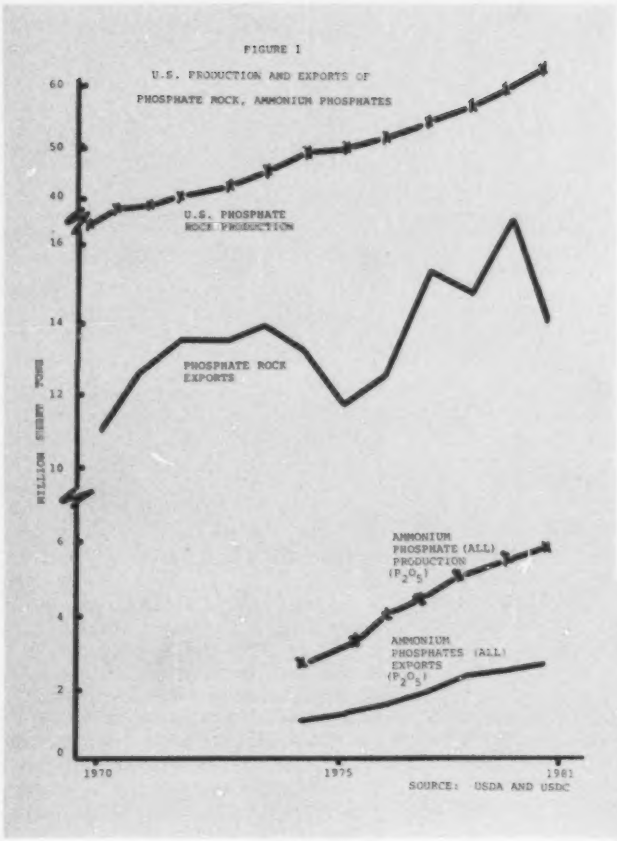


FIGURE 1

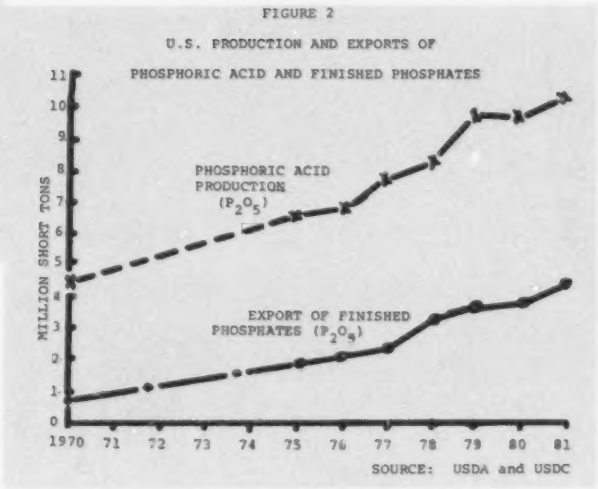


FIGURE 2

port of nitrogen products. For a number of years, the U.S. was a dominant net exporter of nitrogen materials. During the seventies this position has been challenged by growing nitrogen imports. In fertilizer years 1975, 1977 and '78, in fact, the U.S. was a net importer of nitrogen, and the balance point has been approached on a number of other years, as well.

Customer Shifts

Changes also occurred in countries which make up the top buyers and the top suppliers of U.S. fertilizers.

Neighboring countries of Canada and Mexico have been consistent buyers of U.S. fertilizers, as have principal countries of Asia and Europe, for many years. U.S. firms also have been good customers of other countries for major fertilizer items.

The top nitrogen suppliers to the U.S. in 1981 are shown, as an example, in Figure 4. Top buyers of U.S. fertilizers are shown in Figure 5.

A factor that has become increasingly important in the last few years has been the influential swing in international fertilizer markets attributed to "third world" or developing nations.

For instance, in fertilizer year 1980, Brazil purchased more than 3.5 million tons of U.S. fertilizer products. The following year that figure dropped by nearly 30% to 2.6 million tons. Korea, a major buyer of U.S. phosphate rock purchased just over 2 million tons of the raw product in FY 1980. In 1981, purchases dropped 15% to 1.7 million short tons.

Another "swinger" has been Poland. Its purchases of phosphate rock dropped from 934,000 tons in 1980, to 731,000 in 1981, to zero in the current year.

Virtually all South American and Central American countries have fluctuated downward in 1981 and current year demand for U.S. fertilizers from earlier years.

The point, of course, is that the developing countries are playing an ever-expanded role in influential "swings" in the international fertilizer market. This phenomenon will continue as the economics and politics of these countries ebb and flow, and will be a major factor in world supply and demand for raw materials and finished goods and products.

Summary

Like other international commodities, major fertilizers have international markets. In the U.S., there is no insulation from these markets . . . for fertilizers enter and leave the U.S. duty free.

This trade is important. It provides the U.S. a good portion of its supply of several key fertilizers. It also pro-

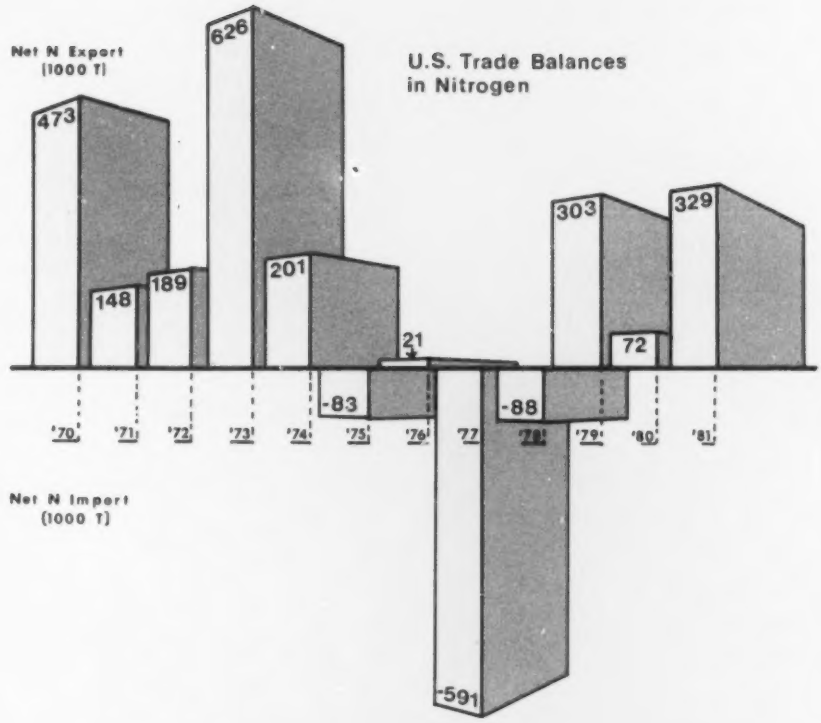


FIGURE 3

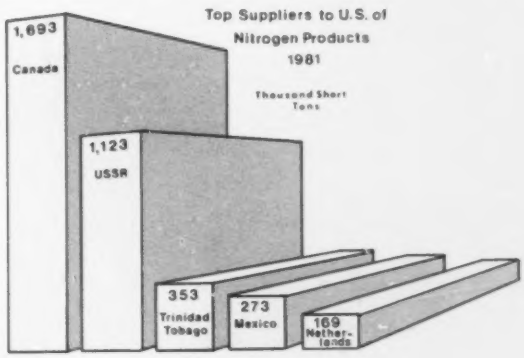


FIGURE 4

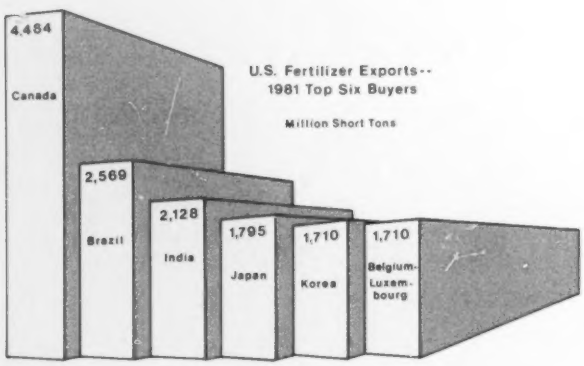


FIGURE 5

vides a healthy balance of trade dollarwise.

In 1981, the value of 29.7 million tons of exported fertilizers was $3.2 billion. The value of 14.3 million tons of imports was $1.3 billion, thus providing a positive trade balance of $1.9 billion. In other words, we exported more than $2 worth of fertilizer for each $1 imported this past year.

There is one other part of the export/import picture worthy of citing. While the U.S. has no tariffs on fertilizer imports, most countries to which the U.S. export fertilizers have duties on these products. Such duties, typically in the range of 5 to 20% on products (including freight costs), go as high as 60 and 82%.

U.S. exports and imports of fertilizer are vital to assure U.S. domestic suppliers as well as the fiscal health of domestic producers. Fertilizers, whether from mineral or hydrocarbon resources, are dependent on wherever, millions of years ago, "Mother Nature" distributed her supplies. Some countries obviously have great reserves, others have little or none. Thus, trade is a distribution of inputs absolutely essential to food and fiber production, whether in India or Indiana.

As use of the critical materials essential for increased crop production intensifies in the future, so will international trade of these products. Thus, the retailer, again whether in India or Indiana, will become more dependent on conditions of the international fertilizer market. Action by dealers in one area toward heavy buying, or slack buying, will directly impact dealers in other areas.

There is an abundance of information today on international fertilizer trade. This "data bank" will grow, providing more instantaneous information, thus cutting reaction time. The well-informed, well-managed retail operation in the future will improve its focus; its picture of international developments with fertilizers.

Professional Consumption of Fertilizers, Pesticides is Billion Dollar Market

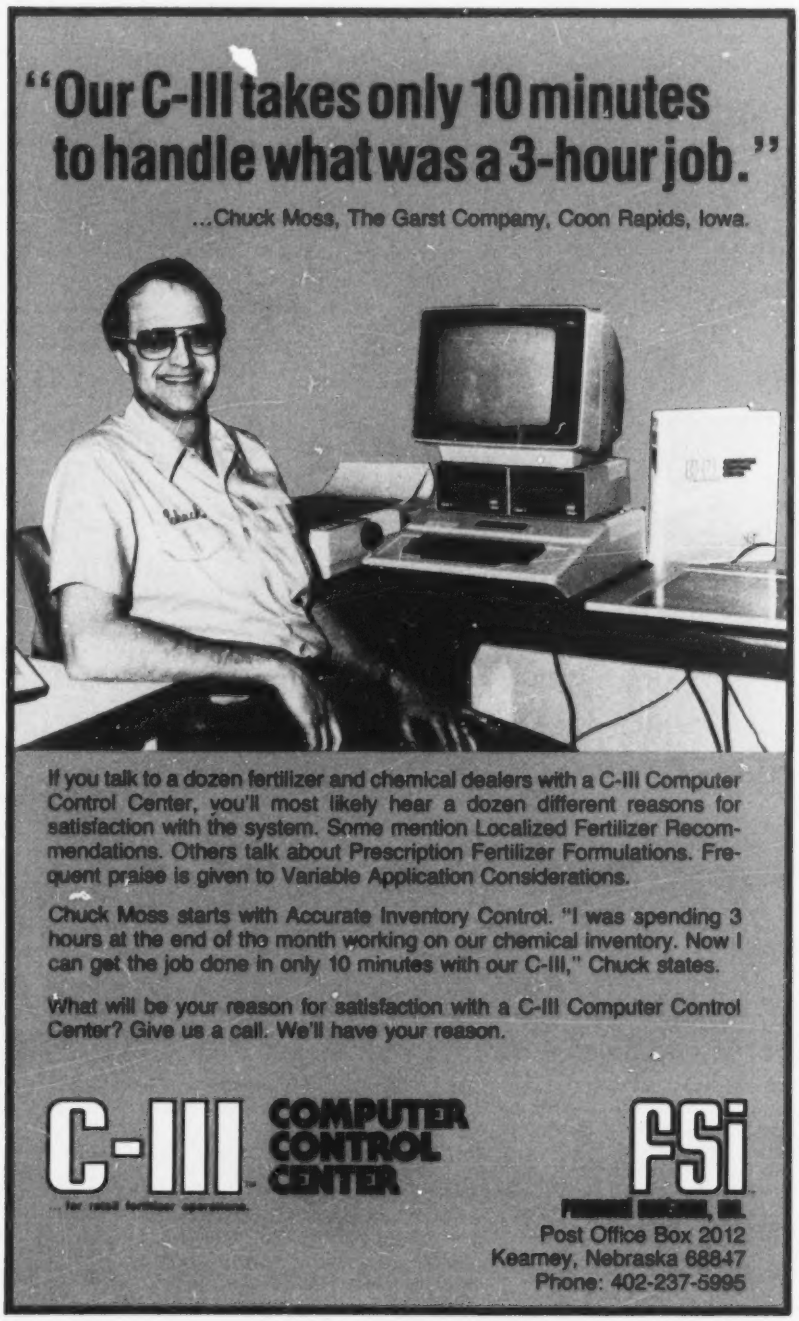
EIGHTEEN end use segments of the professional market consumed pesticides and fertilizers valued at $1.1 billion in 1981. Residential and commercial lawncare firms are the largest end use with consumption of $185 million, followed by golf courses, pest control operators, landscaping firms, horticultural companies, roadways, educational facilities, water management groups, and a variety of other professional end users, a new survey from Charles H. Kline & Co. shows.

Pesticides, comprised of herbicides, insecticides, fungicides, rodenticides, and other products are the leading category with 1981 sales estimated at $664 million. Herbicides are the leader here and are used principally by roadways, railroads, electric utilities, and industrial weed control, according to *Professional Markets for Pesticides and Fertilizers*. Insecticides, ranking second, are sold chiefly to structural pest control operators but also to landscapers and lawn service companies, mosquito-control groups, and horticultural companies. Fungicides, aquatic pesticides, rodenticides, growth regulators, and nematocides make up the balance of pesticide consumption.

Fertilizers, which account for over one-third of the market, rank next in sales after pesticides, Kline & Co. reports. They serve nearly all end-use segments but are most important for golf courses, landscaping, and lawn service. **Soil conditioners** represent the balance of sales.

About half of these sales are held by 20 major suppliers. Dow is the largest with insecticides as its primary product. Du Pont, the largest supplier of herbicides to the professional market, ranks second in sales.

According to the Kline & Co. survey, this segment of business holds important opportunities for alert suppliers. For example, they predict that government pressures will threaten the use of various pesticides including organophosphates, and replacements must be developed. Other opportunities center around improved products, including more effective growth regulators; packaging designed for reduced handling, measuring, and spillage.


"Our C-III takes only 10 minutes to handle what was a 3-hour job."
...Chuck Moss, The Garst Company, Coon Rapids, Iowa.
If you talk to a dozen fertilizer and chemical dealers with a C-III Computer Control Center, you'll most likely hear a dozen different reasons for satisfaction with the system. Some mention Localized Fertilizer Recommendations. Others talk about Prescription Fertilizer Formulations. Frequent praise is given to Variable Application Considerations.
Chuck Moss starts with Accurate Inventory Control. "I was spending 3 hours at the end of the month working on our chemical inventory. Now I can get the job done in only 10 minutes with our C-III," Chuck states.
What will be your reason for satisfaction with a C-III Computer Control Center? Give us a call. We'll have your reason.
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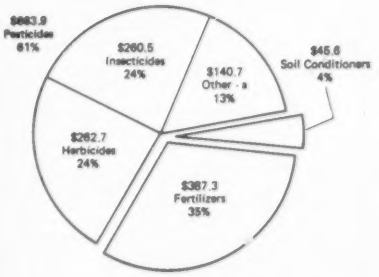
U.S. PROFESSIONAL CONSUMPTION OF PESTICIDES AND FERTILIZERS BY PRODUCT 1981

Millions of dollars



a - Includes fungicides, aquatic pesticides, rodenticides, growth regulators, nematicides, and avicides.

MAJOR SUPPLIERS OF PESTICIDES AND FERTILIZERS TO PROFESSIONAL MARKETS RANKED BY DOLLAR SALES 1981

Company	Chief products
Dow	I
DuPont	H
O. M. Scott	F
Velsicol	I
Ciba-Geigy	H
Monsanto	H
Union Carbide	I
Estech	F
U.S. Steel (USS Agrichemicals)	F
Diamond Shamrock	H
Chevron	I
Lebanon	F
Southern Mill Creek	I
Sierra	F
NCH	I
Lakeshore	F
Hopkins	I
Occidental	F
Fisons-Western Peat	SC
Elanco	H

Code: F-Fertilizers
H-Herbicides
I-Insecticides
SC-Soil conditioners

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